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The **Geographical Review.** Vols. 1–20, 1916 to date. Successor to the *Bulletin of the American Geographical Society*. Monthly, 1916–1920; quarterly since 1921. Monthly numbers, 50 cents; quarterly numbers, $1.25; unbound volumes, 1916–1920 (two a year), $2.50; from 1921 (one a year), $5.00.

China: **Land of Famine.** By WALTER H. MALLORY. With a Foreword by DR. JOHN H. FINLEY, President of the American Geographical Society. With 91 photographs and 12 maps. xvi and 199 pp. *Special Publication No. 6.* 1926. $4.00.

Problems **of Polar Research.** By 31 AUTHORS. 479 pp.; 96 maps, diagrams, and photographs. *Special Publication No. 7*, 1928. $5.00.

The **Geography of the Polar Regions.** By OTTO NORDENSKJÖLD and LUDWIG MECKING. 370 pp.; 135 maps, diagrams, and photographs. *Special Publication No. 8*, 1928. $4.00.

The **Coral Reef Problem.** By W. M. DAVIS. 596 pp.; 227 maps, diagrams, and photographs. *Special Publication No. 9*, 1928. $6.00.

Richard **Hakluyt and the English Voyages.** By GEORGE BRUNER PARKS. With an Introduction by JAMES WILLIAMSON. With 32 half-tone plates, mainly reproductions of portraits, drawings, old maps, title pages, manuscripts, etc. xvii and 289 pp. *Special Publication No. 10*, 1928. $5.00.

Brief History of Polar Exploration Since the Introduction of Flying. By W. L. G. JOERG. Accompanies A Physical Map of the Arctic and A Bathymetric Map of the Antarctic, both maps in color and on scale of 1 : 20,000,000. 95 pp., 9 text maps. *Special Publication No. 11*, 2nd, revised, edition, 1930. $5.00.

Peru **from the Air.** By LIEUTENANT GEORGE R. JOHNSON. With text and notes by RAYE R. PLATT. With 142 aerial photographs and 11 maps and sketches. xii and 159 pp. *Special Publication No. 12*, 1930. $5.00.

The **Pioneer Fringe.** By ISAIAH BOWMAN. With 175 photographs, and 75 maps and diagrams. xii and 361 pp. *Special Publication No. 13*, 1931. $4.00.

Pioneer **Settlement.** By 26 AUTHORS. With 98 maps and diagrams. viii and 473 pp. *Special Publication No. 14*, 1932. $4.00. *Nos. 13* and *14* purchased together $7.50.

The **Grand Coulee.** By J HARLEN BRETZ. With 37 photographs, 16 line drawings, 8 stereoscopic views, and a separate map in color. x and 89 pp. *Special Publication No. 15*, 1932. $4.00.

New England's Prospect: 1933. By 27 AUTHORS. With 9 double page maps, 26 smaller maps and 13 diagrams. ix and 500 pp. *Special Publication No. 16*, 1933. $5.00.

Bering's Voyages: An Account of the Efforts of the Russians to Determine the Relation of Asia and America. By F. A. GOLDER. Vol. 1: **The Log Books and Official Reports of the First and Second Expeditions, 1725–1730 and 1733–1742.** With a chart of the second voyage, by Captain E. P. BERTHOLF. Vol. 2: **G. W. Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.** Translated and edited by F. A. GOLDER and LEONHARD STEJNEGER. *Research Series Nos. 1 (1922) and 2 (1925).* The volumes will not be sold separately. $8.00.

The Vegetation and Soils of Africa. By H. L. SHANTZ and C. F. MARBUT. With a section on land classification by the joint authors and a note on a rainfall map of Africa by J. B. KINCER. With 1 text map, 49 photographs, and a separate case of two maps (in color) 1 : 10,000,000, each with inset, 1 : 25,000,000, showing vegetation (on inset: soils) and land classification (on inset: annual rainfall). x and 263 pp. *Research Series No. 13*, 1923. $5.00.

Peopling the Argentine Pampa. By MARK JEFFERSON. With 55 photographs, 9 maps, and 4 diagrams. viii and 211 pp. *Research Series No. 16*, 1926. $4.00.

The Last Glaciation, With Special Reference to the Ice Retreat in Northeastern North America. By ERNST ANTEVS. 292 pp.; 30 maps and diagrams and 9 separate plates. *Research Series No. 17*, 1928. $3.50.

Oriental Explorations and Studies, Nos. 1–6. By ALOIS MUSIL. No. 1. **The Northern Ḥeğâz: A Topographical Itinerary.** xii and 374 pp. 1926. $7.00; No. 2. **Arabia Deserta: A Topographical Itinerary.** xvii and 631 pp. 1927. $8.00; No. 3. **The Middle Euphrates: A Topographical Itinerary.** xv and 426 pp. 1927. $8.00; No. 4. **Palmyrena: A Topographical Itinerary.** xiv and 367 pp. 1928. $7.00; No. 5. **Northern Neǧd: A Topographical Itinerary.** xiii and 368 pp. 1928. $7.00; No. 6. **The Manners and Customs of the Rwala Bedouins.** xiv and 712 pp. 1928. $8.00. Each volume fully illustrated with photographs, maps, drawings, and plans.

Map of Hispanic America, 1 : 1,000,000 [15.78 miles to 1 inch], Provisional Edition. 42 sheets of this map have now been published. An index map to the sheets may be obtained upon request. $2.00 each sheet.

The Leardo Map of the World of 1452 or 1453. Colored reproduction (measuring 28⅝ x 23¾ inches, printed on sheet 35 x 30 inches) of map in the collections of the American Geographical Society. Accompanied by volume containing text by JOHN KIRTLAND WRIGHT describing the original map and a note by A. B. HOEN on the method of reproduction, with 3 photographs and 7 maps. viii and 90 pp. *Library Series No. 4.* 1927. $15.00 ($2.00 for text alone).

Atlas of the Historical Geography of the United States. By C. O. PAULLIN. With 166 plates comprising over 620 separate maps. xiv and 145 pages; text; index. Published jointly by the American Geographical Society and the Carnegie Institution of Washington and distributed by the Society. 1932. $15.00.

Separate Maps published in the *Geographical Review* and the *Bulletin of the American Geographical Society*, the majority in color. 25 cents each. A list will be sent upon request.

THE
GEOGRAPHICAL REVIEW

VOL. XXIII JANUARY, 1933 NO. 1

GARDENS OF THE MACKENZIE

W. D. Albright

THE two longest river systems of North America are counterparts. The Mississippi runs southward to a tropic sea; the Mackenzie northward to arctic brine. From the source of the Missouri to the Gulf of Mexico the former is 4220 miles long. From the source of the Finlay down the Peace, Slave, and Mackenzie rivers to Mackenzie Bay, on Beaufort Sea, the mileage is 2525. In each case the trunk stream flows through a sedimentary lowland. The drainage basin of the Mississippi comprises 1,244,000 square miles; that of the Mackenzie about 682,000. The former has a latitudinal range of 21 degrees, from near the 50th to the 29th parallel; the latter crosses 16 degrees between the 53rd and 69th parallels.

It would surprise no one to find gardens throughout the length of the more southerly system, but how far down the northern river can fruits and flowers and vegetables be grown? Surely not to its delta, where on July 12, 1789, the explorer of the Mackenzie found frost at a depth of six to eight inches! And yet—but we must not anticipate.

In 1930 the author was commissioned by Dr. E. S. Archibald, Director of Experimental Farms, Dominion Department of Agriculture, to proceed down the Mackenzie River to its mouth, to visit the several experimental substations conducted by the Roman Catholic Missions there, to report upon the advisability of extending experimental work in that field with a view to national stock-taking, as it were, to inquire into the possibilities of interesting the natives in fur farming, and to make a general agricultural reconnaissance of the Mackenzie Basin.

From Beaverlodge in the Upper Peace country transport was by rail 435 miles east-by-southeast to Edmonton; thence 305 miles north-

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FIG. 1

FIG. 2

FIG. 1—Fitzgerald, within a few miles of the sixtieth parallel. View looking north. (Photograph by Royal Canadian Air Force.)
FIG. 2—Simpson, on an island below the confluence of the Liard and Mackenzie. View looking east. (Photograph by Royal Canadian Air Force.)

FIG. 3

FIG. 4

FIG. 3—Good Hope, on the Mackenzie, within twelve miles of the Arctic Circle. (Photograph by Royal Canadian Air Force.)
FIG. 4—Aklavik, in the Mackenzie delta, over a thousand miles north of Edmonton. View looking east. (Photograph by Royal Canadian Air Force.)

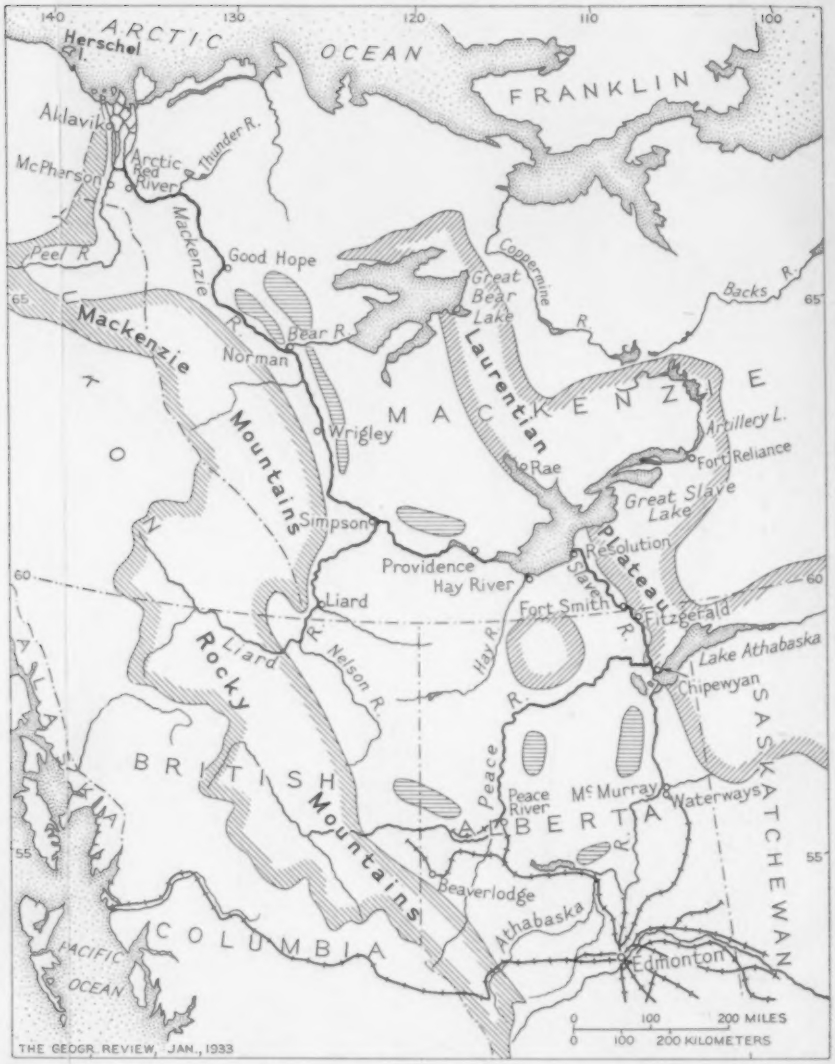

FIG. 5—The Mackenzie Basin showing main physiographical provinces after Charles Camsell and Wyatt Malcolm: The Mackenzie River Basin, *Canadian Geological Survey, Memoir 108*, 1919. On the west is the Cordilleran province; on the east, the Laurentian Plateau; between, the Great Central Plain with surface broken both in the south (Alberta Plateau) and the north (Mackenzie Lowlands) by uplands. Scale of map approximately 1 : 15,000,000.

by-northeast to Waterways, the depot of Fort McMurray, Alberta, on the Athabaska River; thence by seaplane of the Royal Canadian Air Force to Herschel Island, Yukon Territory, in Beaufort Sea. The return trip included a circuit of Great Slave Lake. The total rail mileage was 1480, the air mileage 4015, and the automobile mileage (in vicinity of the Slave River) 100.

Edmonton, capital of Alberta, is 314 miles north of the inter-

national boundary. A few decades ago only a depot of the fur trade, Edmonton today is a city of over seventy thousand and the center of one of the most flourishing agricultural regions of America. From points in Alberta and the "Peace River Block" of British Columbia lying wholly north of Edmonton, 21,545,836 bushels of wheat and 8,746,814 bushels of coarse grains were loaded during the 1931 crop year, while 75,032 head of livestock were shipped during the calendar year.

FIG. 6—The author's home at Beaverlodge in the Peace River district of Alberta, September 17, 1932.

The present agricultural settlement of the Peace, centered some 300 miles northwest of Edmonton, has already won four international championships in wheat, two in oats, and three in peas, besides four reserve championships and many first prizes. A volume might be written about the gardens of the Peace, but space is reserved for the valleys beyond.

AT THE GATEWAY TO THE NORTH

On a bend of the Athabaska River where it turns sharply northward on its last leg to the lake of the same name is the old trading post of Fort McMurray, 220 miles north of Edmonton. Two or three tributaries enter here, and the place seems to receive some extra precipitation. The river-flat site is backed by high wooded hills.

Here the Gordons, William and his sister Christina, have been established more or less permanently since the days of the Klondike rush. On July 2, 1930, their staked marrowfat peas averaged 36 inches in height; three weeks later the same peas averaged 5 feet. Potatoes stood thigh-high in dozens of luxuriant gardens. Cabbages, turnips, and all the usual range of hardy vegetables were incredibly rank. Strawberries were clustered on the vines in Hugh Macdonald's back yard.

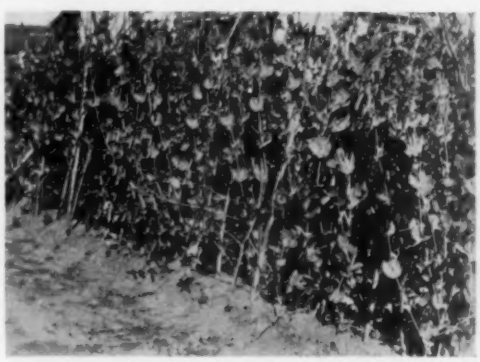

FIG. 7—Peas in the garden of Angus Sutherland, McMurray, Alberta, July 23, 1930.

But the show place of McMurray is the flower garden of Cecil Potts. A spruce tree planted twelve years before, when it was 8 or 10 inches high, had attained a height of 21 feet. Birch grows well and is represented by fine specimens. A good lawn had been made from the native turf. The sweet peas were a sensation, while the range of other flowers ran from portulaca to a choice assortment of gladioli (see Fig. 8).

FIG. 8—Flower garden of Cecil Potts, McMurray, July 23, 1930

And yet they were complaining of a dry season at McMurray! All places appear to have their off seasons when visitors happen along. The weather improved after the author's departure. August brought copious rains, and Miss Gordon wrote that when frost caught her scarlet runner beans at the end of August they were 18 feet tall. According to reports the seasons of 1931 and 1932 proved equally favorable.

PRIZE-WINNING WHEAT FROM ATHABASKA

In 1778 Peter Pond is said to have arrived on the Lower Athabaska, presumably towards its delta, and there he planted the first garden in what is now the Province of Alberta. Alexander Mackenzie, finding it a few years later, pronounced it as fine a kitchen garden as he had ever seen in Canada. Nearly a hundred years later the Roman Catholic Mission at Fort Chipewyan was awarded a bronze medal for wheat at the Philadelphia Centennial. Chipewyan is on the north shore of Lake Athabaska, 357 miles north of Edmonton.

Itself established in 1847, the Mission still carries on. In a drained slough between polished rolls of glaciated rock a fine flower and vegetable garden flourished. The vegetables included celery, beans, and

tomatoes. At the end of September 700 sacks of potatoes were harvested from 70 planted. The vines were unhurt by frost and were cut to facilitate the removal of the tubers. As a rule there is some frost in the fore part of September.

The most beautiful garden in Chipewyan was that of Mr. and Mrs. Thomas Woodman. Vines, flowers, lawns, shrubbery, and birch trees embellished a fine home flanked by valley walls of granite. Wild

FIG. 9—One of William Gordon's potato fields, McMurray, July 24, 1930.

cucumber vines shaded the veranda, some on the east wing attaining a height of 24 feet. Intermingled were Japanese hops and tall nasturtiums. Among the flowers unfailing success is met with calendula, lavatera, sweet alyssum, zinnia, kochia, eschscholtzia, mignonette, cornflower, cosmos, petunia, clarkia, godetia, balsam, nasturtium, sweet pea, schizanthus, snapdragon, portulaca, stocks, verbena, African daisy, linum, everlasting, etc. The aster bed was a wonderful sight and was not spoiled with frost until October 16. Even such tender things as nasturtiums and cucumbers were unscathed until October 10. Vegetable successes in 1930 included cucumbers, tomatoes, marrows, and mushrooms.

Radiation of heat from the surrounding rock masses, plus lake influence, probably accounts for the warding off of autumn frost in a latitude 671 miles north of the United States.

On the east side of the Slave River, opposite the Wood Buffalo Park, Charles Hilker grows not only good vegetables, including celery and tomatoes, but in 1931 produced a plot of No. 1 hard wheat. In that year there had been but slight frosts to September 12. Sunflowers were then ripening, the largest being 10 inches across. He had red tomatoes, roses in bloom, and was still eating strawberries.

FIG. 10—Fort Smith, North West Territories. (Photograph by Royal Canadian Air Force.)

At the end of July, 1932, despite a frost on June 21, he had corn in tassel. His flower garden of thirty varieties was a mass of color. Sunflowers volunteering from 1931 were in full bloom. His vegetables were good, and he had tomatoes the size of hens' eggs.

Later he reported that wheat (the early varieties Reward and Garnet) sown May 5 grew 3¼ to 3½ feet tall and, because of blackbirds, was cut August 8 on the green side, yielding at the rate of 31½ bushels an acre (1890 pounds) and showing no sign of frost injury. On August 14 Pickaninny sweet corn had perfect cobs 5½ inches long. Tomatoes and cucumbers ripened. The season had been characterized by light showers of insufficient volume.

THE FARTHEST-NORTH TOWN IN ALBERTA

At the head of the rapids on the Slave River is Fort Fitzgerald, within a few miles of the sixtieth parallel. As we circled over the town a strange sight met our eyes. A mile north, carved out of the poplar bush, was a well-appointed homestead resembling an experimental station. Here were neat plots of wheat and oats from seed supplied from Beaverlodge. On July 3 Steve Yanik's wheat was 23

FIG. 11—Hay River post at the entry of Hay River into Great Slave Lake. View looking northeast by east. (Photograph by Royal Canadian Air Force.)

to 28½ inches tall, oats 23 to 25½ inches. On July 19 the grain was headed, both wheat and oats standing 3 feet, 8 inches. The grain was cut on the green side on August 16 after wind and rain had lodged it badly. The oat straw then averaged 5 feet, 3 inches, the wheat, 5 feet. The wheat graded mostly No. 1 and No. 2 Northern at Edmonton; the oats, 1 C. W. and 2 C. W. (see Figs. 12 and 13).

The garden was equally remarkable. Roses bloomed the year of planting, wintered successfully with protection and bloomed again in 1931. Lilacs, Zumbra cherries, and pin cherries blossomed. Raspberries, gooseberries, strawberries, blackberries, black and red currants all ripened in 1931. Potatoes have been grown at Fitzgerald for forty years, and all the patches observed appeared promising. In 1931 Mr. Yanik reported 920 bushels from 3 acres. In 1932 he produced fine samples of grain.

BEYOND THE SIXTIETH PARALLEL

On a 120-foot bank along the majestic Slave, just below the rapids, is Fort Smith, N. W. T., 446 miles north of Edmonton. A generation

ago Warburton Pike pronounced it the most disreputable establishment he had seen in all the north. Today with its orderly, red-roofed, white-walled buildings it is one of the prettiest towns one would wish to view from the air. Once the southern beach of a much larger Great Slave Lake than now exists, the site of Smith is a sandy soil supporting a native forest growth almost exclusively of jack pine.

The long summer days give an amazing fillip to growth. In July, 1930, corn at Smith was far ranker than on the same date in the Peace. New potatoes were being used on July 21. Two-inch tomatoes were produced from seed sown in the open ground without protection. Seed onions attained a diameter of nearly two inches. Verbena and phlox filled the flower beds until covered with snow about October 9.

The most famous garden of Fort Smith is that of Mrs. L. Conibear, who regularly succeeds with sweet-william, scarlet lychnis, Iceland and California poppy, caragana, bush honeysuckle, Japanese sunflower, Siberian perennial lavatera, larkspur, ribbon grass, gypsophila, pyrethrum, achillea, and columbine. She does not deny that gardening north of sixty has its disappointments. Spring is late, the summer is usually short, and rainfall often scant. In 1930, however, there was still blossom on potato vines until at least September 17, and cellars were stocked with first-quality vegetables. The summer of 1931 proved droughty, but gardens were again fairly good, and a letter dated September 11 reported no hard frost to that date. The season of 1932 was droughty too, and growth was small, except where watering was practiced.

Apple Culture on Great Slave Lake

At McMurray one feels he is getting north, but that is not the north at all—only the gateway. At Fitzgerald and Smith he regards each horticultural success as an amazing triumph over latitude, but he is told that he should see Resolution; they have apple trees there.

Fort Resolution is on the south shore of Great Slave Lake 526 miles almost due north of Edmonton. In front of the Roman Catholic Mission are two seedling apple trees which have been bearing for years. The fruit is small but is used for pickles and jam. Each tree when seen was several inches in trunk diameter, was ten or twelve feet tall, and had hundreds of apples. In 1930 the larger specimens selected made 20 pounds of good jam, and in 1931 a wireless crop report concluded "apples plentiful."

Field and garden crops were good. In 1930 the Mission harvested 775 sacks of potatoes from 70 planted. Cabbage attained an average weight of 15 pounds a head. The early summer of 1931 was less favorable, but from the end of June conditions were excellent except for a hot, dry period in July.

An Old Garden at Hay River

At the entry of Hay River into Great Slave Lake is the old post of Hay River, where the Anglican Church Mission has long had a successful garden. The soil is eighteen inches of black-silt loam overlying sand. Four hundred bushels of potatoes were gathered in 1930 along with a considerable assortment of other vegetables. Tomatoes and celery were notable achievements. Three weeks' time produced fine radishes from a sowing made in hot July weather after a rain.

Half or three-quarters of a mile upstream is the police post, where gardening is ordinarily less successful than near the lake though never without some reward. In 1930 the first killing frost there was September 7, but the flowers planted close to the house were untouched until October 5. Celery has not succeeded; but tomatoes do well, though they have to be ripened indoors.

Hay River is 506 miles north of Edmonton. Spring growth is retarded by latitude and lake influence, though the latter compensates in the autumn. In 1930 ice had not cleared from the shore until June 9, when it was driven back by a south wind. In 1931 the season appears to have been less favorable owing to dry weather in June and July, with cloudy weather in half of August and in September.

Up to about the second week of July conditions were promising in 1932, but from then until about the end of August no rain fell at Hay River. The six weeks of drought coupled with intense heat were hard on vegetables. Cabbage at the Anglican Mission refused to develop during this period but did better subsequently. Cauliflower, strangely enough, produced large, firm heads, which were in constant use after the middle of August. Flowers did well with watering. Fodder corn planted May 26 was 3½ feet high by September 7. The cobs were small with partly developed kernels. Alfalfa, sweet clover, and grasses sown in the spring became from 20 inches to 2 feet in height. Early varieties of wheat (Garnet and Reward) grew about 3½ to 4 feet tall, maturing patchily. Some of the better-matured heads submitted were reasonably well filled. Banner oats were good, and barley was excellent. Sunflowers were not killed until near the end of September. In October Corporal Cook of the Mounted Police submitted excellent samples of grain and told of hyacinths, gladioli, and asters having done well.

Potatoes Double Their Height in a Week

Beyond the embouchure of Hay River the western arm of Slave Lake tapers down into the beginning of the Mackenzie. On its north bank a little below where it assumes river proportions is Providence. A Roman Catholic Mission was founded there in 1862. In 1867, when confederation was being accomplished, Sisters of Charity came

FIG. 12

FIG. 13

FIG. 14

FIGS. 12 and 13—Wheat and oats on Steve Yanik's place at Fitzgerald. Figure 12 was taken July 3, 1930: the wheat was 23 to 28½ inches tall, oats 23 to 25½ inches. Figure 13 shows the same rows 16 days later: some of the wheat was 4 feet, 4 inches tall, the oats about 3 feet, 8 inches.

FIG. 14—John Goodall's potato field at Simpson, July 8.

from Montreal, and gardening has been conducted from about that date. Celery has done well at times and occasionally tomatoes. Corn was in silk on July 17. The Hudson's Bay Company manager had a good potato patch.

On an alluvial island below the confluence of the Liard with the Mackenzie is Simpson, 578 miles north of Edmonton. Cropping has been conducted there for many years. After leaving steelhead one heard reiterated "You should see Simpson." We saw it twice. The growth that occurred in ten days is contrasted pictorially (Figs. 15 and 16).

Domestic livestock was kept as far north as Simpson, and at the Oblate Mission the visitor dined on home-produced eggs, butter, milk, onions, and other local produce. More than 50 acres of land was under crop, and its yield is supplemented by wild hay. Father Robin explained that some gardening and farming efforts have been carried on since 1858 or 1859.

A typical potato plant selected for measurement doubled in height in a week. Potato tubers, carrots, and rutabagas grew very large. The Mission was threshing grain in August. In this and other gardens on the island more than a thousand sacks of potatoes were produced in 1930.

Rev. C. F. Clarke, the Anglican missionary, testified that in ten years he had never seen a failure of the potato crop. His own vines made practically the same growth as those at the Roman Catholic Mission, being 18 to 22 inches on July 17. The writer really could not see that one religion was better for potatoes than the other. One of Mr. Clarke's delphiniums stood 7 feet, 5 inches by July 17. White clover had wintered successfully. The caragana shrub was flourishing. For the second season in ten he ripened tomatoes in the open air. He had also achieved a success in producing winter eggs, using artificial light, heat, and cod-liver oil.

FIG. 15

FIG. 16

FIG. 17

FIGS. 15 and 16—Potato field of the Oblate Mission, Simpson. Potatoes were planted May 20. One staked plant measured 10¾ inches on July 7 (Fig. 15); on July 14, 21½ inches; on July 17 (Fig. 16), about 24 inches.

FIG. 17—Potato garden of the Oblate Mission at Aklavik, July 11, 1930. Potatoes planted June 14 measured 3 to 6 inches. The ground was broken only four years ago.

The best husbandman at Simpson is John W. Goodall, who had farmed for fourteen years at Athabaska Landing, going to Simpson in 1927 with the idea of catering to the local demand for truck. In 1930 his Netted Gem potatoes showed an increase ratio of 25 to 1. Squaw corn produced a mess of roasting ears. Tomatoes ripened in the house all fall. Marrows were raised from seed sown in the open. The first killing frost in 1930 fell on September 24–25.

In 1931 the season was dry, and grasshoppers, a hot-climate pest, multiplied. Yet, with the help of a little irrigation good gardens were again grown. Goodall's experience convinces him that anyone with a small plot of ground can produce more than his household can use of the choicest summer and winter vegetables.

Another garden seen in 1930 had onions growing from seed sown in 1929 and wintering outdoors; sunflower stalks, which afterwards became ten feet tall; and corn, which afforded several feeds of sweet corn on the cob.

Hoppers threatened gravely in 1932; wet weather, however, checked the pest in time, and a bountiful harvest was gathered. Mr. Clarke was using new potatoes eight weeks after the planting of cellar-sprouted sets. In the autumn eight thirty-foot rows yielded eight sacks. By actual weight two rows averaged over 700 bushels an acre. Goodall had 450 bushels an acre from unmanured land given no special cultivation. Despite a frost on September 3 he had garden corn and 40 varieties of flowers. Canary creeper was still blooming on the north side of his house on October 5, while pansy, antirrhinum, phlox, and stocks were still surviving the autumn winds. The settlement produced about 1200 sacks of potatoes in 1932 and is looking to supply the Great Bear Lake mining trade.

Washtubfuls of Tomatoes on the Liard

Unfavorable flying conditions precluded a coveted side trip up the Liard, but several upriver residents were met at Simpson, and astonishing were the experiences related. Their statements were afterwards checked as might be in official quarters.

Martin Gardner is a Norwegian who in 1923 went from a homestead in the Peace to trade on the Nelson, where he remained until 1932, when he headed for Great Bear Lake. In seven years he had never had potatoes frozen until September and sometimes not until October. In the summer of 1925 he stuck tomato seeds in the ground here and there and in the fall had two washtubfuls of ripe tomatoes. He extolled the climate of the Liard as superior to that of the Peace.

Rev. Father J. C. Lefebvre, who is in intimate touch with the Northern Oblate Missions, tells of very successful farming and gardening efforts upriver at Fort Liard and expresses the opinion that

the whole region of the Liard is as favorable for cultivation as the Peace. John A. McDougal, until recently the chief government official resident in the Mackenzie District, was quite as complimentary in his opinion.

Almost certain it is that, unless checked by legislative control, settlement will soon be crossing from the Upper Peace to the headwaters of the Liard, pressing down that river, and probably meeting another vanguard working up from Simpson.

Petroleum and Potatoes

We return to the Mackenzie. Wrigley is situated on the west bank of the river where it speeds through a trough hemmed by low mountain ranges. It is a ramshackle place with a magnificent situation. A fair garden was found at the Hudson's Bay Company post, and wild fruits were laden on July 9.

Where the Bear River pours its cold, clear current into the muddy Mackenzie, Fort Norman, the oil-well town, stands on two benches, one thirty or forty feet above the other. On both levels natural vegetation was rank. On July 15 a stem of grass measured 5 feet tall. Most of this growth had been made since the middle of June.

The Catholic Mission on the upper bench had a fine garden. One patch of potatoes had vines averaging 5½ to 6 inches, and during the next five days they grew an inch a day. At the end of September Father Houssais reported that the summer had been warm and dry. The first frost of two degrees came on August 28; another of two degrees on September 7; but the potato leaves were scarcely touched, being still green and unflattened when the crop was lifted on the twelfth. Some of the tubers were as large as a double fist. One of the turnips weighed 8½ pounds. Many of the carrots were more than a foot in length. Peas matured and began to shell towards the middle of August. The cabbages had enormous leaves but were not too well headed.

In 1931 results were again very favorable, although worms ate the cabbages. Despite a frost at the beginning of June, 1932, potatoes were better than the year before. Cabbages averaged 8 pounds. Peas and lettuce were enjoyed all summer. Norman is 787 miles farther north than Edmonton.

At Norman we met a Swede, Oscar Granath, who lived seventy miles downstream at Oscar Creek. In 1929 he was using potatoes 55 days after planting. Potato seed balls gathered from the 1929 crop produced small tubers. Subsequent reports were that Granath had a wonderful garden in 1930, much better than any at Norman. The following season, he admitted, was not so good, though his potatoes from seed continued to develop well.

FIG. 18—Norman at the junction of the Bear River and Mackenzie. View looking west. (Photograph by Royal Canadian Air Force.)

YIELDS AT GOOD HOPE

Just below the famous Ramparts of the Mackenzie and within twelve miles of the Arctic Circle, Fort Good Hope perches on an abrupt bench some sixty feet high, with a deep slough behind, affording air drainage in nearly all directions. For many years this point supplied the Lower Mackenzie with potatoes. The Roman Catholic Mission was established on its present site in 1862, and potatoes have been grown on the same land almost without fertilizer for about 66 years (Fig. 20).

On the evening of July 12 an impressive sight met the eye. Blossoming potato vines were 20 inches high and a picture of health.

FIG. 19—Arctic Red River, a short distance above the head of the Mackenzie delta. View looking north. (Photograph by Royal Canadian Air Force.)

It was all spade work at Good Hope, there being in 1930 no draft animals north of Simpson except dogs. A large amount of seed is required, but the acre yields are respectable. There were several patches, some not planted under the best of conditions. Also there was a killing frost on August 17, so that the Mission's average potato yield in 1930 was only 393 bushels an acre. They had not been artificially watered.

All the staple vegetables did well, while Reward and Garnet wheat plots seeded May 21 were harvested August 9, slightly on the green side for fear of rain. Two hundred and twenty-five cabbages reached a maximum weight of 12 pounds. Good Hope is 869 miles north of Edmonton.

North of the Circle

Some eighty miles north of the Arctic Circle is Thunder River, a small tributary entering the right bank of the trunk. "Clark's place" furnished on July 13 one of the horticultural surprises of an eye-opening voyage. One thousand two hundred and seventy-seven

FIG. 20—Potatoes and cabbages in the Oblate Mission garden at Good Hope, July 14, 1930. Ramparts of the Mackenzie in the distance.

miles north of the international boundary, carved out of the moss-bedded spruce forest, were two flourishing gardens. The owner had been out with his motor boat gathering blueberries with a picker. On hearing the planes he returned with two pailfuls of ripe berries, remarking that the country was covered with blueberries from end to end. There were also wild raspberries, strawberries, red and black currants, but no saskatoons. For the fourth successive season Clark was gardening successfully, raising potatoes to the size of goose or duck eggs. In 1930 his place was making a wonderful showing. The carrot tops on July 13 stood 6 to 9 inches tall; beets 7 to 9 inches; peas 12 to 24 inches and well podded; Swedes 8 to 15 inches; cabbages 6 to 8 inches; potatoes 7 to 10 inches; beans 6 to 9 inches and ready to blossom; oats and barley 30 inches tall and shooting. Lettuce was being thrown away by the armful. The beans had been covered one night for fear of frost.

In the adjacent thinly wooded muskeg a stick touched frost at 6 to 12 inches. In the garden cultivated for a few years the soil was thawed to a depth of 34 inches. Thunder River is 963 miles north of Edmonton.

The season finished strong. Frost on August 16 damaged only beans and potatoes, which latter nevertheless yielded 370 bushels

an acre although grown from non-sprouted sets. The cabbages all headed well, and fifty weighed more than 8 pounds apiece. The little patch of grain ripened. Clark declared that a garden in that country was worth $500.00 a year to a man with a family.

The next summer was not so favorable. Frost got the beans and potatoes on July 26, but the other vegetables were again productive.

FIG. 21—Vegetable garden of William Clark at Thunder (Travier) River, 80 miles north of the Arctic Circle, July 13, 1930.

Barley from the previous season's crop was seeded May 22, headed July 19, and ripened August 14, growing 34 inches tall. Oats seeded May 22, headed July 23, and ripened August 18 when 46 inches high.

Mr. Clark was afraid to tell about the crop he raised in 1932! Everything except parsnip was immense. From 42 pounds of potatoes cut to one-eye sets he dug 985 pounds, a ratio of 1:23.5. Three sacks averaged half a pound to the tuber. Cabbage from seed sown in the open on May 16 ran from 6 to 14 pounds. Poppy, pansy, dianthus, and sunflower did well. Sweet clover grew 4 feet tall; oats and barley ripened. Splendid samples were forwarded by plane. One of two pumpkins ripened. No frost came till September 5 and then only a light one.

ICE-JAM IRRIGATION AT ARCTIC RED RIVER

With the sun still swinging an hour or so high the planes landed at the mouth of the Arctic Red River twenty-five minutes before midnight on July 10.

"Any gardens here?" was the unexpectant inquiry.

"Sure," answered D. McLeod, "come up and see mine." The garden sloped sharply down from his residence, which stood perhaps

40 feet above the water's edge. True enough, there was the universal patch of potatoes, clean and neat. They had been planted June 4 and were promising a yield. In a little corner at the foot stood a patch of grain planted May 17 and inundated directly afterwards by an ice-jam flood. The irrigation appeared to have done it no harm, for the wheat was 2 feet tall and in the shot blade. The barley measured 2 feet, 9 inches and was heading. Blue joint (*Calamagrostis*) and other grasses stood breast high. Fireweed was rank in full bloom. Wild currants, gooseberries, and raspberries grew luxuriantly. The currants were especially heavily laden. Yet on untilled land the frost had withdrawn but a foot or so, and water trickled in the midnight sun from the northward face of a cellar excavation being made in the frost-bound, peaty soil.

Arctic Red River is an important tributary of the lower Mackenzie. The confluence is 962 miles north of Edmonton.

Rhubarb Pie in the Delta

At 1.30 a. m. of July 11 we landed at Aklavik, flying by mid-evening because it was cooler for the engines—there is really no midnight in early July. Mid-day heat was oppressive.

Aklavik is in the delta. It is about 60 miles from Mackenzie Bay and 1015 miles north of Edmonton. We pictured it as in the bleak tundra country. There, surely, would be no gardens, for was not one assured that the frost never drew out all summer to a greater depth than 6 or 8 inches?

The first surprise was the heat. At 1.30 a. m. we rode 2000 feet in the air with perfect comfort, bareheaded, and lightly clad. The next surprise was the forest, occupying the islands and bordering the river though not reaching far back from it in that latitude. Spruce trees 8 to 10 inches thick were plentiful, with odd specimens 70 or 80 feet tall and up to 18 inches in diameter, it was said.

And behold the ubiquitous potato! Planted June 14 the crop then stood 3 to 6 inches tall, later producing some tubers the size of hens' eggs. In a corner of the garden were rhubarb plants that had overwintered and made stalks big enough to use for pies.

In 1925 Father Trocellier had founded the Mission. The next year ground was broken for a garden. At first it was only 6 or 8 inches through moss to the frost. Radish, lettuce, and potatoes had been planted. The radish did well, but the lettuce was small. The potatoes grew only 6 or 8 inches tall the first year, but tubers the size of walnuts were produced and planted the next season. After that they yielded each year a little more than the seed. Double and single daisies came through one winter without care.

Rose haws, dewberries, and fruiting currants were observed.

Mooseberry and blueberry were said to occur, and gooseberries grew farther east. In autumn the author received seed of crowberries and moss cranberries.

In the unbroken forest frost had drawn to a depth of only 6 or 8 inches, as the explorer of the river had observed 141 years before. On land burned over on the first of June it had drawn 12 inches. In the garden the measuring stick pushed down 24 inches. It had been thus in the Yukon.

J. Parsons, the Hudson's Bay Company manager, said conditions at McPherson, over on the Peel River, were more favorable for gardening than at Aklavik. He had grown lettuce, spinach, radish, and turnip and could produce "tons of them." In 1914 he had seen it 90° F. in the shade at McPherson, at which point wild raspberries, blueberries, and yellowberries were found.

The summer of 1931 was a cold one with bad ice conditions in the sea. Potatoes had been killed August 11 by a frost following a snow storm. The rhubarb, however, grew well. October airmail messages from Aklavik reported success in 1932 with lettuce, carrots, and potatoes, and the author received plump, well ripened samples of barley and oats. Even wheat produced fair-sized kernels although not of milling grade.

No gardens were observed on Herschel Island, but the wild flowers on the hillside were abundant and in mass effects of the richest hues—red, purple, blue, white, and gold. Legumes were considerably in evidence. Grass grows, although not very tall.

Seeking Gardens on Great Bear and Slave Lakes

Inquiry in 1930 failed to reveal any gardening efforts around Great Bear Lake, but in 1931 Hugh S. Spence, of the Department of Mines, Ottawa, found vegetables growing on some raw sand and clay laid bare at Labine Point in the mineralized area east of the lake. Lettuce, radish, carrot, and beet had been planted June 14. The carrots and beets did nothing, but the radish grew and the lettuce cut two or three crops. Unverified newspaper allusions suggest that more ambitious attempts were made in 1932.

At the upper end of the north arm of Great Slave Lake is Fort Rae, 642 miles north of Edmonton, built on bare glacier-polished Laurentian rock. No gardens here surely!- Yet as the plane circled over the settlement three very thrifty ones were espied. In depressions near the water the Oblate Mission had literally "made" gardens by carrying in rich soil found in crevices farther back. Representative potato plants found on July 17 measured 13, 14, and 21 inches in height, nearly covering the ground and coming into bloom. Here Father La Perriere has annually raised potatoes, cabbage, lettuce,

beets, carrots, turnips, and peas. After a very light frost the potatoes were lifted September 20, some of them averaging 14 ounces.

Domestic strawberries were one of the surprises. Some plants were flourishing in cannisters on the balcony of a Ukrainian trader's home. Others were growing in the Mission garden.

Unlike most of the river points, Fort Rae was blessed with a still more favorable season in 1931. By the end of September Father La Perriere wrote that only potato leaves had a touch of frost and the crop was better than in 1930. There was "enough lettuce and spinach to feed an army." Mice, however, had eaten the strawberries, root, stem, and leaf, during the preceding winter, leaving wild ones untouched.

Lettuce and Radish for Musk-ox Rangers

No cultivated crops were growing at Reliance at the extreme eastern end of Great Slave Lake, presumably because none had been planted; but 40 miles east, at Artillery Lake out near the edge of the musk-ox preserve (Thelon Game Sanctuary), a Swede had grown lettuce, also radishes an inch in diameter. Oats and wheat headed but failed to ripen.

The author did not visit the east end of Lake Athabaska, but his traveling companions who did so in the companion plane reported potato patches there too. He who would outrun the potato in the North has a long chase.

In relating this tale of horticulture in the Mackenzie Basin one realizes he is countering an instinctive discount of high latitude. Truth is that the ecological influence of latitude is largely offset by declining altitude, by long summer days, by the lowering frost plane as the result of gardening itself, and, shall we add, by montane or oceanic influence?

Three seasons have been reviewed in some detail, the first exceptionally favorable, the second one inclement at the more northerly points. At the worst something is produced. At the best production must be seen to be believed. Factors accounting for the phenomena will be discussed in a future article.

AGRICULTURAL CONDITIONS AND REGIONS IN GERMANY*

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THE agrarian crisis in Germany reflects the geographical basis of the country's agriculture. Compare for instance the situation of the farmer fattening cattle on the low-lying North Sea *Marschen* with his neighbor of the sandy *Geest*. The rich pastures of the marshland support a high grade of beef cattle, and for long years before the war the farmers of the North Sea coast were correspondingly prosperous. Today the price of meat has declined to a phenomenally low level. In the fall of 1931 fat cattle were selling at 6 to 7 cents a pound where they had been bought lean in the spring for 10 cents a pound. But humid climate and lowness of the land make it exceedingly difficult to convert these pastures into arable. On the contrary the farms of the sandy Geest are more diversified and adaptable, and their cultivators are therefore in a relatively better situation. While the great farms of eastern Germany have been hard hit by the high interest charges for business credits, the tiny farms of many mountain villages in the industrial regions of the south cannot support the families who have lost their auxiliary or principal occupation. In other regions there are other difficulties. Altogether they present a picture of the varied conditions under which agriculture is pursued in Germany.

The area of Germany within its present boundaries is only about one seventeenth that of the United States, or about that of the East North Central states (of the U. S. Census divisions) without the lumbering and less highly developed agricultural regions in the north between the lakes (Fig. 1). On this small surface dwells a population of 65 million, almost three times as many as in the East North Central states. Like the latter it is highly developed industrially, and the largest proportion of the population lives in cities. In addition to its great cities Germany has an unusual number of medium-sized cities and on the average a much denser population in the rural regions

*In collaboration with other German experts Professor Max Sering has made a study of the background, the present economic situation, and the possibilities for development of German agriculture. The voluminous report "Die deutsche Landwirtschaft unter volks- und weltwirtschaftlichen Gesichtspunkten" is published as *Berichte über Landwirtschaft*, No. 50 (N.S.), 1932. The purpose of the present article is to present the geographical results of this work, and in this the writer is guided chiefly by his own contribution, Chapter 4, Die Grundlagen der deutschen Landwirtschaft und die Anpassung des Landwirtschaftlichen Betriebs an die veränderten Wirtschaftsbedingungen, pp. 208-278.

than the East North Central states. In the latter the number of farms is about a million, in Germany five million, three-fifths of which are less than 5 acres.

Like the East North Central states Germany may be divided into three major agricultural regions (Fig. 1). Just as the cultivation of corn is highly characteristic of the former, so is that of rye and potatoes

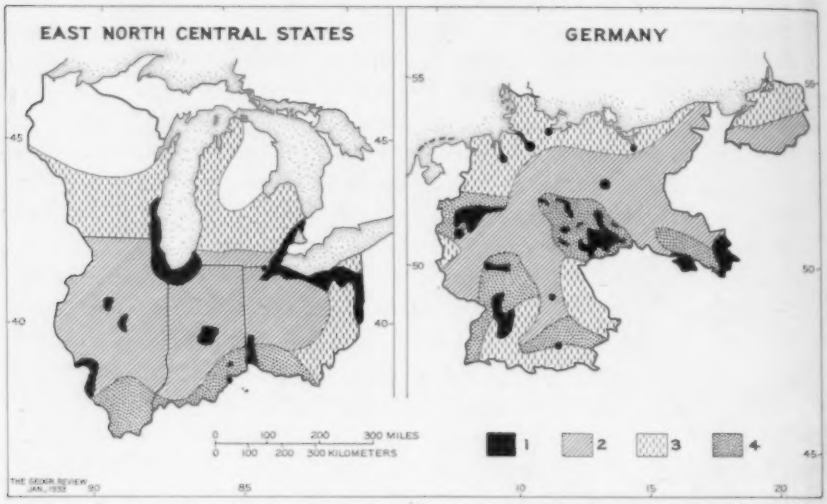

FIG. 1—The East North Central States (U. S. Census division) and Germany compared. Key: 1, industrial areas; 2, corn belt in the United States, rye-potato-oats belt in Germany; 3, dairy belt, hay, pasture; 4, wheat-corn belt in the United States, wheat, barley, sugar beet in Germany.

for Germany. Germany does not have the hot and wet summers that are necessary for corn, nor any considerable areas of the excellent clayey soils of the corn belt. The winter-wheat region is comparatively small in both countries. In this zone, in addition to wheat, corn is cultivated in the East North Central states, barley and sugar beets in Germany. In both countries hay and pasture occupy large areas and are the basis of an extensive cattle industry. Germany has about twice as many beef cattle, milch cows, and hogs as the East North Central states and needs to import a part of their feed (oil seed and oil cakes, barley and corn). The dairy belt of the East North Central states lies chiefly along the Great Lakes near the industrial cities; in Germany, far from the principal industrial regions, on the coasts in the north and the Alpine foreland in the south.

THE SOIL

Diverse as Germany is in rock structure and topography, most of the soils developed under a forest cover. At the beginning of the Christian era forests still covered the larger part of the land and even today occupy a little more than a quarter of the surface.

On the extensive areas of sandy "forest soils" (compare Fig. 2) in northern and eastern Germany only unexacting crops such as rye, oats, potatoes flourish. Wheat and barley do not generally find satisfactory conditions on these poor, dry, leached soils. Oats can be cultivated only in the humid climate of the maritime border or where the ground water comes near the surface. In the alluvial river valleys the grass of all meadows that are not artificially drained is rank and sour. Between meadows too moist and soils too dry the north German plain encounters much difficulty.

Of still less value for agriculture are parts of the highlands in central and southern Germany with too steep slopes, too stony ground, or a cold, damp, clayey soil. The sandy and mountain soils shown in Figure 3 cover about one-sixth of the agricultural area of Germany. Parts of them have become marginal land under the competition of mechanized farming on the fertile steppe lands of the world.

Germany's share in the steppe lands is small, the great southeastern European steppe zone extending into the country only as small islands (Fig. 2). The brown and black steppe soils, mostly of loess, were already settled in prehistoric times; but in consequence of their natural fertility and careful cultivation and fertilization, these soils even after more than 2000 years yield larger harvests than the less intensively worked steppe lands in southeastern Europe and in North and South America. The other soils shown in Figure 2 in the hilly land, in the large river valleys, and on the coast consist of loam, clay, sandy loam, and loamy sand, most of them of average to good fertility. The loess soil, which occurs in many places in the hilly land and to a greater unbroken extent on the northern side of the central ranges and on the neighboring plain (compare Fig. 6), is very fertile. It differs from the loess of the steppes only in that it has suffered somewhat from leaching.

German agriculture seeks to obtain high yields by the expenditure of much labor and capital on an area small in comparison with the number of inhabitants. The soils are thoroughly tilled and fertilized. Large areas require drainage. Where the rivers are regulated the valley meadows are irrigated. The surface irrigation of crops is unknown in Germany, but overhead irrigation, which is often employed in market gardens, has been introduced into some of the larger agricultural enterprises.

Rainfall and Temperature in Relation to the Growing Season

The average yearly rainfall in Germany is about 28 inches; on the North Sea coast, in the foothills, and the low mountains, it averages more than this; in the hilly, rolling, and plain regions generally less.

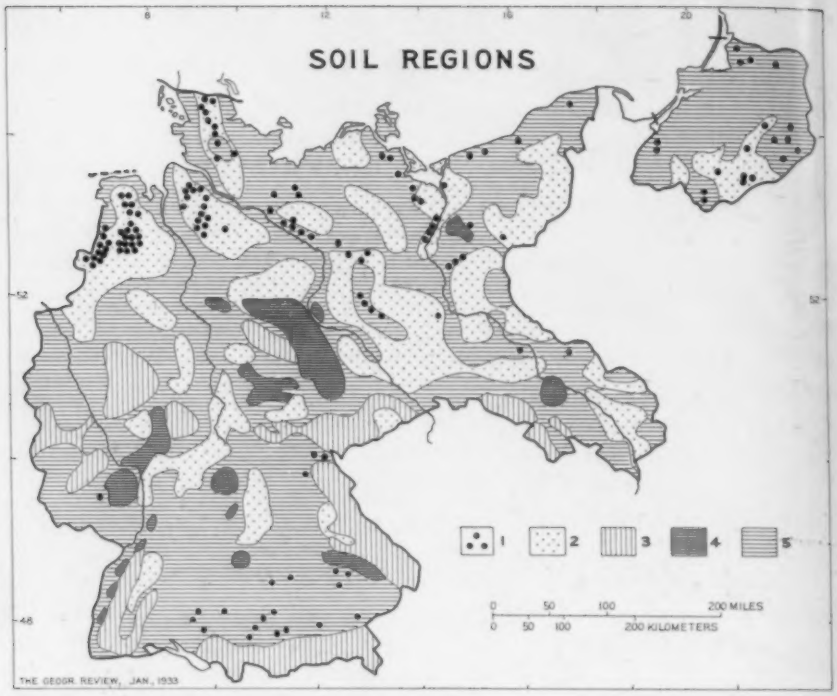

FIG. 2—Soil regions of Germany. Key: 1, moor soils; 2, sandy soils; 3, mountain soils; 4, steppe soils (black and brown soils); 5, mixed types ranging from sandy loams to clay.

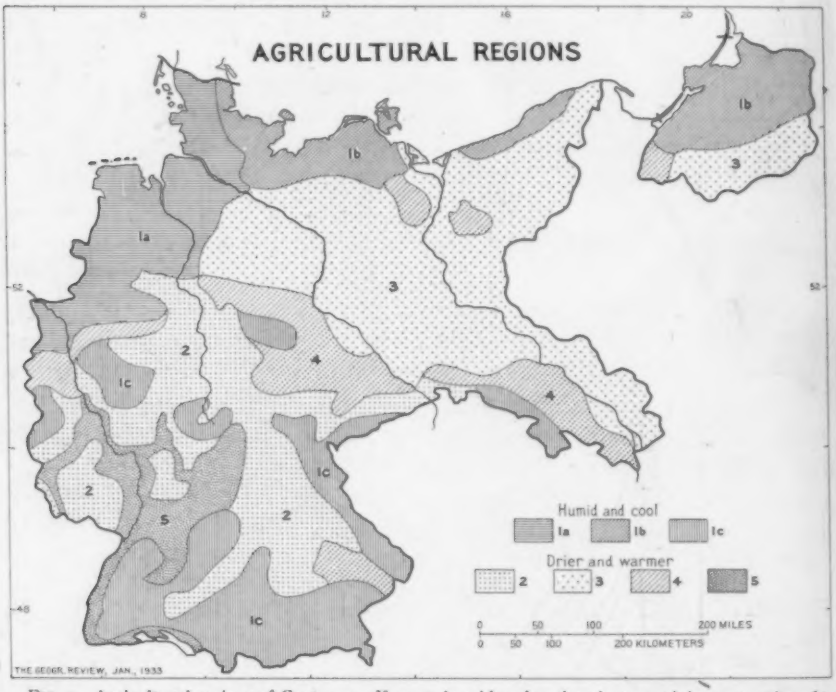

FIG. 3—Agricultural regions of Germany. Key: 1, humid and cool regions, receiving more than 60 per cent of the income from livestock: 1a, lowlands—dairying and beef; pasture, hay, forage crops; 1b, rolling land—dairying; forage crops, pasture; 1c, foothills and low mountain ranges—dairying; hay, pasture; II, drier and warmer regions, receiving 40 per cent and more of the income from crops; 2, hilly—grain and livestock; forage crops; 3, plain and rolling—rye, potato, livestock; 4, plain and rolling—wheat, barley, sugar beet, livestock; 5, river bottoms and hilly land—wine, fruit, grain.

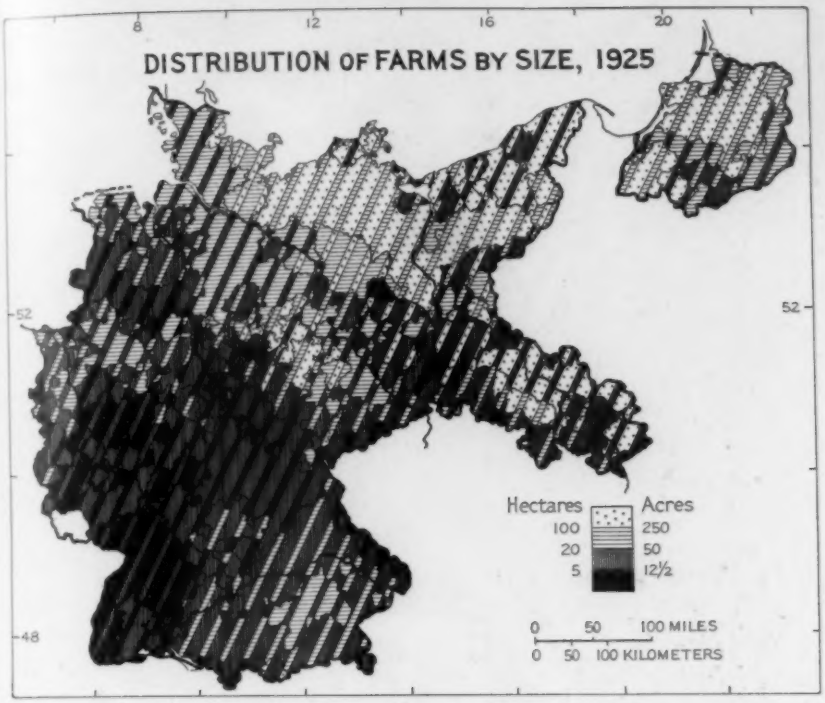

FIG. 4—Distribution of farms by size in Germany.

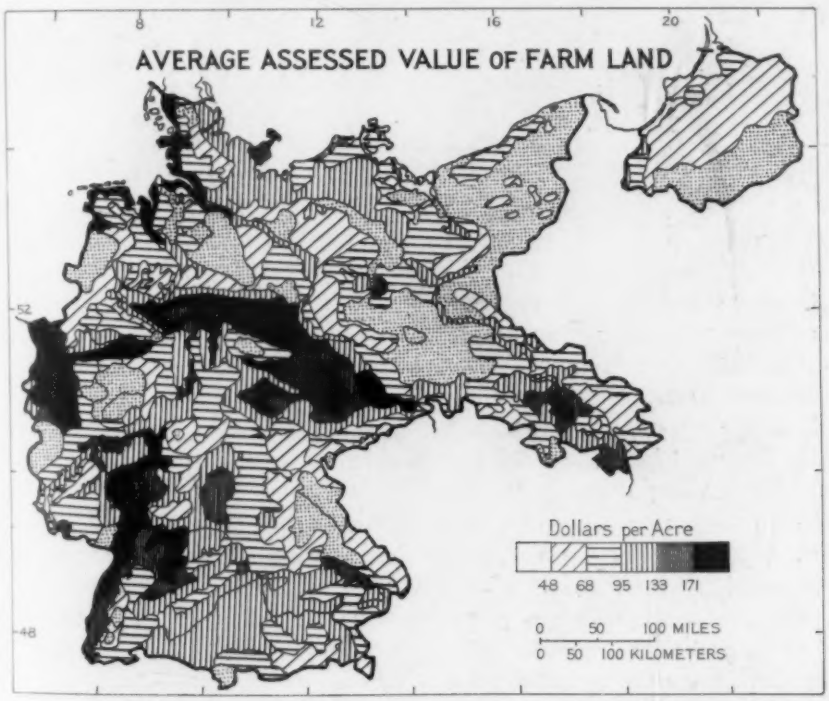

FIG. 5—Average assessed value of farm land in Germany in dollars per acre. Compare with the map of agricultural regions, Figure 3, and see pages 45–47.

In central and eastern Germany the plain has for the most part less than 24 inches of rain; in some particularly dry parts even less than 20 inches. That is no more than in the eastern Great Plains. Thus the rainfall at the three German stations of Halle, Bernburg, and

FIG. 6—Relief map of Germany. The line of small circles marks the southern limit of the ice sheet of Pleistocene time. The dotted line shows the pre-war boundaries of Germany.

Prenzlau averages 19 inches a year, exactly the average of Dodge City (Kan.), Bismarck (N. Dak.), and North Platte (Neb.). Eastern Germany has a temperate continental climate. In the wild flora are to be found south European (Pontic) elements. The period of growth is notably shorter than in western Germany. In East Prussia the duration of the snow cover and of the freezing of the lakes and streams is about 80 days. The continentality of the climate, however, is far less marked than in the East Central states.

In the mountainous parts of Germany the local variations in climate are marked. Warm, dry valleys lie between wet heights. In the distance of a few miles the difference in rainfall often may be as much as 20 inches. Everywhere, however, Atlantic influences prevail—there is no gateway for the southern grape climate, as France has between the Pyrenees and the Alps. Only in the deep-sunk and protected valleys of southwestern Germany are certain varieties of the Mediterranean flora to be found.

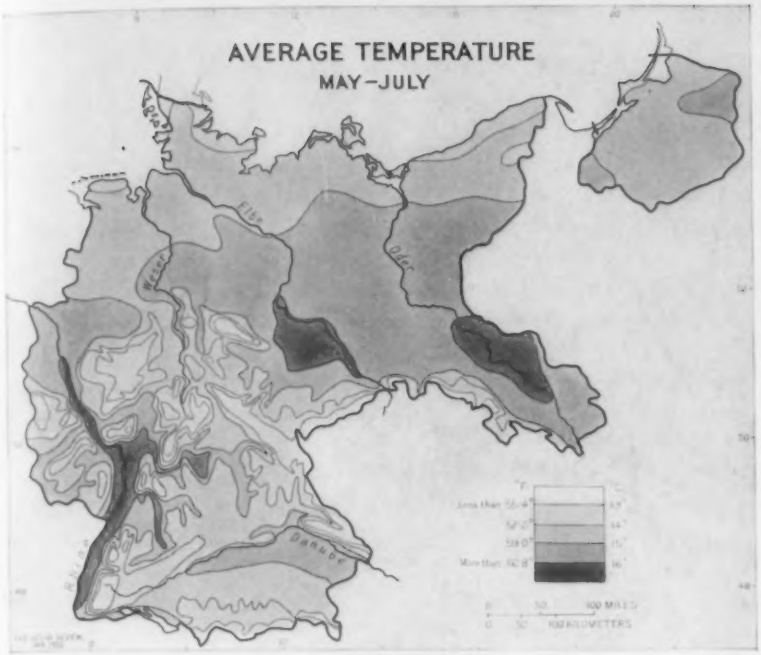

FIG. 7

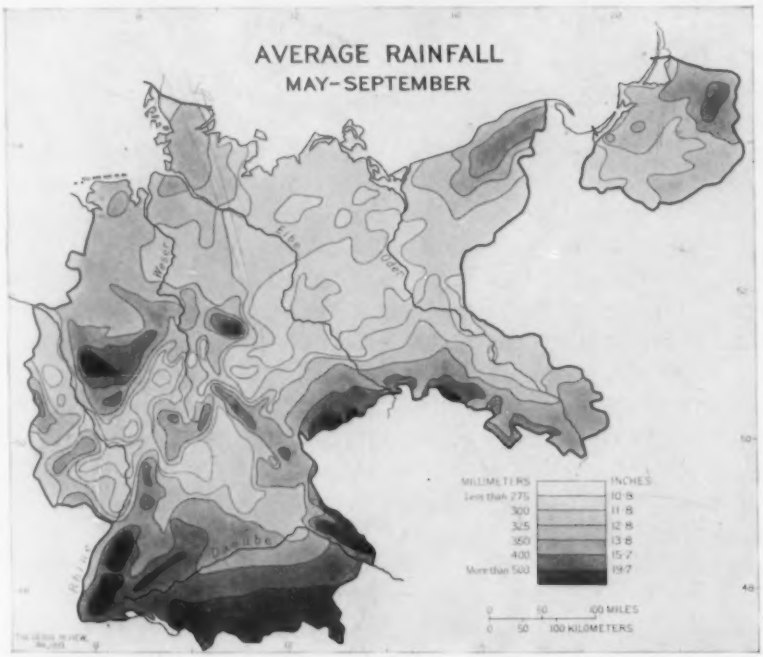

FIG. 8

FIGS. 7 and 8—Temperature and rainfall during critical months. Figure 7 shows the average temperature from May to July; Figure 8 shows the total rainfall received on the average from May to September.

The climate of Germany, to be sure, shows characteristic regional differences, but each of these climatic types is distinguished by stability, which is a prerequisite for a good adaptation of agriculture to the climatic conditions. Without a certain stability in the climate agriculture is a hazardous game. Within certain fixed boundaries, however, the weather of Germany is very unreliable, especially in the regions of Atlantic climate, where rain and sunshine follow one another often several times the same day. Many tasks are rendered much more difficult thereby, especially at harvest.

Figures 7 and 8 give a picture of temperature and rainfall conditions in Germany in the principal growing season. June is characterized by cool northerly winds, especially strong on the coast. In the region under their influence low summer temperatures and low evaporation prevail, and there is, therefore, a high degree of effectiveness from rainfall and winter moisture. These regions have an average temperature from May to July of only 55°–59° F. (13°–15° C.). Similar temperatures prevail on the high areas and in the mountains. In the Great Lakes region (Cleveland, Detroit, Chicago), on the other hand, in the months May to July the average temperature is about 66°, a difference reflected in the absence of the vine in the corresponding German area and in the dominance of oats, rye, clover, grass, and root crops. The valleys of southwestern Germany show temperatures of about 60°–62° F. Here the vine flourishes on the sunny valley walls; malt barley, wheat, lucerne, tobacco, poppy, and fruit are intensively cultivated. On the east the warm zone of the east German plain with temperatures of from 59° to 61°, in some places up to 62°, penetrates wedgelike between the cool coastal zones and the central ranges. It is a region of highly cultivated crops on the southern good soils with wheat, barley, and sugar beets predominating, on the sandy soils, rye and potatoes. This sunny plain is after all about 10° cooler than the interior of the East North Central states, where in the corn belt average temperatures of 72° prevail from May to July (Cincinnati, Indianapolis, Cairo).

Figure 8 represents the total rainfall in the principal growing period, May to September. Only the border mountains and their foreland in the south and southeast receive large amounts. Parts of the country have no more rainfall than the Great Plains. In central Germany and in some basins protected from the west by mountains only 11 to 12 inches of rain falls from May to September. By far the greatest part of the country must get along with less than 16 inches in the chief growing season, a low figure compared with that of the eastern United States. The average rainfall from seven stations from May to September in Michigan and Wisconsin is 20–21 inches, the average from eight stations in Illinois, Ohio, and Iowa about 19 inches. The difference is partially counterbalanced by the greater

moisture content of the air under oceanic influences in Germany than in the continental climate of the United States. If it rains less, it evaporates less also. In the months of May to July the coasts belong to the driest regions of Germany; however, with the exception of the central part (Mecklenburg, Western Pomerania), they receive much rain in August, September, and October. This wet late summer is especially favorable for pasture but a great drawback for grain, potato, and sugar-beet cultivation. As a consequence the coastal regions and the rainy Alpine foreland market principally beef cattle, milk, butter, and cheese.

Everywhere in Germany, however, diversified farming prevails, and the climate permits the cultivation of a variety of crops and the keeping of livestock of all kinds.

The Size of Farm Operations

Germany has an unusual number of small farms. A comparison with the East North Central states shows this. The figures of the census of 1925 may be taken as approximately, if not entirely, comparable. The East North Central states have some 113 million acres of land in farms, Germany 103 million. The area of the crop land is about equal, some 65 million acres.

Germany		East North Central States	
Size in Acres	*Number of Farms*	*Size in Acres*	*Number of Farms*
5 – 12½	894,454	Less than 10	49,442
12½– 50	956,155	10– 50	215,518
50 –250	199,825	50–260	735,794
250 –500	8,901	260–500	45,703
More than 500	9,767	More than 500	5,115
	2,069,102		1,051,572

Outside of the two million farms of over 5 acres Germany has three million agricultural establishments of less than 5 acres. These small holdings do not in general suffice for the sustenance of the family and furnish the farmer only supplemental earnings. The essential agriculture of Germany lies preponderantly in the farms of from 12½ to 50 acres; in the East North Central states, in the farms of from 50 to 260 acres. Farms of from 260 to 500 acres are five times as numerous in the East North Central states as in Germany. On the other hand it is especially noteworthy that the very large farms—over 500 acres—are almost twice as numerous in Germany. Indeed, these 9767 large farms comprise almost as much land as the 3.9 million farms of less

FIG. 9—A region of varied agriculture in a country of varied agriculture. Aerial view in the Swabian Jura. Meadows on the valley floor; crops on the gentle slopes; luxuriant forest on the steep white limestone terraces and mountain crests; crop land and pasture on the plateau levels. Zone 2. (Photograph by Photogrammetrie, Munich.)

than 12½ acres. The large farms are almost exclusively in the eastern half. Here the farms of from 250 to 500 acres and the farms of over 500 acres together comprise about two-fifths of the area. In western Germany, on the other hand, the larger farms are almost entirely lacking; most of the land here belongs in farms that are 12½ to 50 acres and 50 to 250 acres in size.

The distribution of the farms according to size (Fig. 4) is explained only in part by economic necessity; it is in a high degree the result of political history, into which we cannot go here. The strength of the German agrarian constitution lies in the fact that in almost all parts of the country it rests upon self-operating ownership. Only 11 per cent of the land is farmed by tenant farmers; in the East North Central states the figure, on the other hand, is 35 per cent. Tenancy is most prevalent in Germany in farms of less than 5 acres and more than 500 acres. About a quarter of these farms are tenant-operated.

Agricultural Regions

Because of the natural diversity of the country it is difficult to delimit agricultural zones. Mixed farming everywhere predominates. There are no agricultural establishments confined to the production of grain, and even among the large farms of the grain belt there are few that do not obtain from at least a third to a half of their income from the sale of animal products. On the other hand those farms that bring to market almost nothing except animal products carry on intensive cultivation on a third of the farm land. According to a valuation by the Statistisches Reichsamt, of the total value of the agricultural products of Germany about two-thirds is derived from animals and animal products and about one-third from cash crops. The combinations are very varied and the regions cannot be defined by a single term. In the following classification (Fig. 3) the initial division is into I, humid and cool regions receiving more than 60 per cent of the income from livestock and II, drier and warmer regions receiving 40 per cent and more of the income from crops. In the subdivisions the nature of the surface is stated first and then in order the distinguishing features of the farming of the region.

I. Humid and Cool Regions

Zone 1a, lowland areas: dairy products and beef; pasture, hay, forage crops.

Along the North Sea is the narrow strip of very fertile alluvial soil of the Marschen, or polders—level, low-lying, protected against the sea by dikes. The most recent alluvium lies directly behind the dikes and is slightly higher than the older deposits. The soil is looser and less leached, and about half of the farm land is arable. Under a cool

forest on the steep white limestone terraces and mountain crests; crop land and pasture on the plateau levels. *Zone 2.* (Photograph by Photogrammetrie, Munich.)

FIG. 10—A typical scene in the *Marschen* of Schleswig-Holstein. Cattle thrive excellently on the rich pastures of these polders reclaimed by man and nature from the sea. Zone 1a. (Photograph by T. Benzinger, Stuttgart.)

FIG. 11—"Geest" landscape in the neighborhood of Bremen. Meadowland on sandy soil comparatively poor in nutritive elements but enjoying a moist climate. Zone 1a. (Photograph by the author.)

FIG. 12—A seventy-five acre farm, arable and pasture, in the valley of the Hase, a tributary of the Ems. The fertile loamy soil contrasts with the poor sandy soil of Figure 2. Zone 1a. (Photograph by the author.)

FIG. 13—A village in Pomerania. In the northern strip along the Baltic Sea Pleistocene glacial deposits give rise to a rolling country of diversified farming in which dairying takes an important place. Zone 1b. (Photograph by Dr. F. Stoedtner, Berlin.)

FIG. 14—Scene in the alpine foreland of Bavaria. There is a good deal of arable in the rolling land of the foothills in the foreground; and the nearer the approach to the mountains the larger the proportion of meadow and pasture. Zone 1c. (Photograph by Dr. F. Stoedtner.)

FIG. 15—Dairy farm in the Allgau district of Upper Bavaria. The row of trees and the fence in the foreground separate meadows and pasture. No arable here. Zone 1c. (Photograph by Dr. Schwenkel, Stuttgart.)

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and humid climate much oats is cultivated, and in addition wheat, horse bean, and winter barley; but the largest part of the Marschen is taken up by great pastures. Here beef cattle, bought lean in the spring, are fattened in the fall as beef of the best quality. In the northern part of the North Sea Marschen the farmers are occupied entirely in grazing shorthorns and crossbreeds. In other parts, however, fattening on the pastures, breeding of beef cattle and horses, and dairying are closely interwoven. Dairying is developed to the greatest extent in the vicinity of the coastal cities. Pastoral farming and the economic size of the herds demand comparatively large enterprises, and farms of from 50 to 250 acres are most numerous. In the vicinity of the cities there are also many small truck farms.

Adjoining the narrow strip of the Marschen is the Geest, some 10 to 20 meters higher. Its sandy diluvial soil is for the most part poor in nutritive material, but in the marine climate is sufficiently moist. Some of the depressions are filled with fertile river alluvium. Broad regions are occupied by moors, large parts of which are cultivated. The natural meadowland makes possible a good dairy and cattle-breeding industry: in most of the farms meadows and pasture comprise more than half of the area. Rye, oats, potatoes, and forage crops are cultivated principally, wheat and barley only in a few places. In connection with the dairy industry and rye and potato growing, hog breeding and fattening has been intensively developed; in the vicinity of Bremen and Hamburg with the aid of imported barley and corn to such an extent that farms have more of a commercial than an agricultural character. Hog raising is an important source of profit, especially for the small establishments of the northwest. The greatest part of the Geest is taken up by farms of between 12½ and 50 acres; in the second place come the small enterprises of less than 12½ acres that have leased their land from the large farms.

Zone 1b, rolling land: dairy products; forage crops, pasture.

The zone along the Baltic Sea is quite different physiographically from Zone 1a. It coincides with the ground moraines of the last glaciation. Beautifully forested ridges and lakes succeed one another and make of this rolling terrain a charming landscape. As in the northwest, summer temperatures are low and humidity is high, and there is much rain in the fall. Consistent with such a climate and a soil of glacial loam and clay, oats, clover, and pastures are predominant. Everywhere a productive cattle and horse-raising industry has been built up on the abundant production of feed. Milk produced in large quantity is marketed in the form of butter and cheese. Fresh milk can be disposed of only in small quantities in this purely agricultural zone, a fact that distinguishes it from the industrialized shores of the Great Lakes in the East North Central states. Rye

occupies a generally larger acreage than wheat, which often suffers from rain during the harvest: only in eastern Holstein wheat and in some places summer barley have wider distribution than rye. The soft wheat of the coastal zone is in part exported to England, where it is used to supplement the American hard wheat. The western part of the zone, Schleswig-Holstein, and the eastern, East Prussia, are especially well known because of their high-standing beef-raising and dairying industries. It was the Holstein farmers who, in the second half of the last century, gave the impetus to the brilliant development of the dairy industry on the Danish islands. The Baltic Sea zone is the principal region of large farms of more than 250 acres (compare Fig. 4). Among them are many with 1200 to 2500 acres.

Zone 1c, foothills and low mountains: dairy products; hay, pasture.

To this zone belong the regions of Germany having the greatest rainfall. Large areas are forested. In the river valleys there is much meadowland with grasses of high protein content, and on the slopes, pasture land with short grass and herbage. The breed of cattle uniformly kept in the uplands gives less milk than the lowland cattle of north Germany, but the milk contains more butter fat. The system of farming is similar to that in neighboring Switzerland. Much butter and cheese are produced and brought to distant markets. Many elevated plains and rough mountain slopes can only be used for extensive grazing, with sheep in addition to cattle. Oats, rye, and potatoes are cultivated on the stony fields principally for use in the home and for fodder. In the best part of this zone, however, in the northern half of the alpine foreland and in the eastern part of Württemberg, wheat, barley, and spelt occupy considerable areas and constitute cash crops on the larger farms. Farms of 12½ to 50 acres comprise the greatest part of the agriculturally used areas of this region (Fig. 4). In the second rank are farms of 50 to 250 acres in the foothills; these even predominate in parts of Upper Bavaria.

The southwestern corner of Zone 1c is the Black Forest, whose deeply cut valleys allow little room for cultivation. More than two fifths of the small plowed areas are devoted to potatoes. The low mountain ranges on the border towards Czechoslovakia are the poorest part of Zone 1c. Here there are forest villages and stray settlements with farms of less than 12½ acres, their occupants dependent upon auxiliary earnings.

II. Drier and Warmer Regions

Zone 2, hilly lands: grain and livestock; forage crops.

The alternation of valleys and heights gives this zone a complex character. In the higher altitudes it resembles Zone 1c: forest and

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FIG. 16—An alpine pasture, *alm*, in Upper Bavaria. Flocks and herds are driven up in the summer, and cheese and butter are produced. The "Sennhütten," herdsmen's cabins, in the winter are sometimes used as shelters by the visitors for winter sports. Zone 1c. (Photograph by Dr. F. Stoedtner.)

FIG. 17—Low mountain country in the western Erzgebirge. Here agriculture is not the chief occupation: most people are engaged in forest and home industries. Zone 1c. (Photograph by Dr. F. Stoedtner.)

FIG. 18—Hilly landscape in Thuringia, a beautiful country rich in historic monuments. Fields of grain and potatoes predominate. Zone 2. (Photograph by Dr. F. Stoedtner.)

FIG. 19—A prosperous village in the valley of the upper Weser, with orchards and grainfields. Plowed fields succeed lush meadows in the broad river valleys. Zone 2. (Photograph by Dr. F. Stoedtner.)

FIG. 20—Much farm land in the "Saxon Switzerland" dates from the clearing of the forests in the Middle Ages. From the village as a center the plowed fields stretch in long strips to the edge of the forest, which still remains on the heights. Zone 2. (Photograph by Dr. F. Stoedtner.)

FIG. 21—A farm in Mazuria. For the most part this is a poor land of sandy and stony glacial soils, with forests and lakes taking up large areas. Farming depends mainly on rye and potatoes and livestock. Zone 3. (Photograph by Professor Wolff, Berlin.)

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pasture land are well distributed but do not occupy so great an area as in the low mountain ranges. Three-field farming prevails with rye, oats, and potatoes, oats especially on the moist and cool northern slopes. The income from livestock is in general greater than that from crops. Zone 2 is more particularly differentiated from Zone 1c by the fertile, warm, and dry valleys and basins, in which an intensive cultivation of wheat and other kinds of grain is carried on, as well as sugar beets and fruit in parts. In the south Zone 2 takes on a special aspect because of the limestone plateau of the Swabian-Franconian Jura. There the valley bottoms are used as meadowland, the gentle slopes of the valley for cultivation, the plateau for cultivation and sheep grazing. Between valley and plateau, however, some of the steep terraces of the white limestone are covered with beautiful forest (Fig. 9). The chief crops are summer barley, oats, and spelt, with hops a special feature in the vicinity of Nuremberg and in the "Hallertau" on the Danube. Practically no horses are kept in the southern part of Zone 2. The upland cow is at the same time a milk, meat, and draft animal, and milk products are limited. More remunerative is the growing of barley for the breweries.

In all of Zone 2 the farms are rather small. Farms of 12½ to 50 acres are in general most widely distributed; but there are also extensive tracts with smaller farms. These are regions where the farm inheritance is subdivided among the children and where the farm population is partly dependent upon additional occupation in industry or in labor on the larger farms in the valleys.

Zone 3, plain and rolling country: rye, potatoes, livestock.

This large wedge-shaped zone of eastern Germany is distinguished by the broad distribution of sandy soil and the comparatively small amount of rain. The landscape owes its character to the Pleistocene glaciation. Particularly distinctive are the many lakes, elongated or highly irregular in outline, that lie among the sandy pine-clad hills. The changing contours of the terminal moraines appear clothed with leafy woods. Between elevated gently rolling sandy plains, on which pine forests and plowed land succeed one another, stretch vast depressions, formerly swamps, today drained and constituting some of the best land of this zone. Loamy stretches also occur in the ground moraine cover in which wheat can be grown. But the typical crops of the zone are rye and potatoes. Only the large streams—Elbe and Oder—are bordered by wide stretches of fertile fresh meadows. The climate is not humid enough for forage crops and pasture, and arable farming is more generally important than cattle raising, especially in the large farms of more than 1000 acres, of which there are many in this zone. In a location favorable for marketing, e. g. in the vicinity of Berlin, these large farms also carry many milch cows.

In the northeastern part of the zone, where market conditions are unfavorable, on the small farms potatoes are fed chiefly to hogs; on many large farms, on the other hand, they are transformed into alcohol, and in the rural cities there are a number of starch and potato-meal factories. The eastern part of the zone, southern East Prussia, is naturally a poor land with forests and lakes taking up large areas and an unambitious agricultural population living on small farms. This part of Zone 3 as well as northern East Prussia, belonging to Zone 1b, suffers from the separation from the rest of Germany by the Polish Corridor. On the contrary marketing conditions in the southeastern part of the zone, Upper Silesia, are materially better as industrial and agricultural enterprises are in close contact. The western part of the zone includes the Lüneburger Heide, mainly a rolling sandy country where the farmers grow rye and potatoes and make use of the wide stretches of pasture and heath for sheep grazing (Fig. 24).

Zone 4, plain and rolling country: wheat, barley, sugar beets, livestock.

On the northern side of the central ranges a strip of very fertile soil extends along the gentle slopes and on the adjoining plain, consisting in large part of loess and in some places having the favorable structure of the steppe soils (compare Fig. 2). In addition to this principal zone there are small patches of similar type in the driest and warmest regions of eastern Germany and in the south on the Danube. This is the real tillage zone of Germany. To be sure, cattle are kept, but the income from the sale of wheat, barley, and sugar beets is more important: in some parts of the zone the cultivation of the last named is the focus of the whole farm system. In parts of the central and eastern sections, where the winter is rather dry, a good malt barley holds first place. The western section falling within the belt of marine climate is excellent for wheat, oats, and rye: and in the immediate vicinity of the Rhenish-Westphalian industrial region dairies are more numerous.

In the sugar-beet regions the cattle industry has been built up on the utilization of the waste from the beets. Sheep-raising for market has also become a part of this economy. Cultivation is very intensive, and by careful tillage wheat yields from 40 to 50 bushels and more an acre. In the west, farms of less than 250 acres are most numerous; in the central and eastern part, however, farms of over 250 acres. The 500- to 1000-acre size here represents capitalistic operations with a yearly gross income of about $100 an acre and more. These farms, to be sure, are greatly mechanized. However, as the growing of grain is closely associated with the cultivation of sugar beets, which requires much hand labor, a 100 per cent mechanization of grain cultivation would be of no advantage.

FIG. 22—Plowed fields and pastures on the outskirts of an industrial town in Upper Silesia. Zone 3. (Photograph by Dr. F. Stoedtner.)

FIG. 23—A grain field in the Brandenburg Mark. Morainic hills in the background. This is typical of the central part of Zone 3. (Photograph by Dr. F. Stoedtner.)

FIG. 24—Sheep grazing, rye and potato cultivation on the sandy central part of the Lüneburger Heide. Zone 3. (Photograph by Dr. F. Stoedtner.)

FIG. 25—Typical landscape in the sugar-beet region of central Germany. Perfectly flat, treeless steppe; in the background an industrial town. Zone 4.

FIG. 26—In the valley of the Danube near Regensburg, where much wheat and malt barley are grown on a fertile loess soil. Zone 4. (Photograph by Dr. F. Stoedtner.)

FIG. 27—Farm in the valley of the Vistula. The level, treeless land has been reclaimed to agriculture (grain, sugar beets, and hay) by drainage. Zone 4. (Photograph by Dr. Wolff.)

FIG. 28—Jugenheim, on the "Bergstrasse," in a region of intensive fruit cultivation on the western slope of the Odenwald. Zone 5. (Photograph by Dr. F. Stoedtner.)

Zone 5, river bottoms and hilly land: wine, fruit, grain.

To this zone belong the valleys of the Rhine, the Mosel, the Main, and the Neckar, with the bordering fertile hilly land. If Zone 4 is called the grain zone of Germany, we can designate Zone 5 as the country's garden—its vineyard and orchard. Where the valleys are narrow and deep the vineyards are laid out in carefully built terraces on the sunny slopes. The opposite bank, turned away from the sun, is forested. Where the valleys are wide, vineyards and orchards and fields of grain, potatoes, green corn, and tobacco appear in a bright mosaic. In noticeable contrast to this intensively cultivated garden landscape are the pine-clad sands of the upper Rhine plain left by the river in its changing course.

FIG. 29—The valley of the Neckar above Heilbronn showing grain and hay fields and the rows of poplars characteristic of the river banks in southwestern Germany. Fruit is also largely cultivated. Zone 5. (Photograph by Dr. F. Stoedtner.)

The growing of grapes and fruit in this zone is, to be sure, a highly important special branch, but it generally forms a permanent part of a farming establishment where the farmer raises grain, potatoes, and milk for his own needs. The hilly region of the Main, the Neckar, and the Rhine plain is a fertile grain-growing country. In the sunny, warm climate wheat, summer barley, and green corn for fodder flourish particularly well. In the hilly land of the Neckar, which in some places receives more rain than the Rhine plain, dairying and forage crops come somewhat more to the fore. The fertile soil, the warm climate, and the close association between agriculture and industry make it possible for a farmer's family to support themselves in many places on only one tenth the area necessary in eastern Germany. Thus farms of less than 12½ acres comprise the greatest part of the area. Only in the distinctly grain-growing regions are farms of from 12½ to 50 acres more numerous. Zone 5 is a beautiful region and the best known to foreigners of all German regions because it lies along the route from Cologne to Basel, most frequented by tourists. But its limited extent shows how little characteristic this zone is of German agriculture as a whole.

Assessed Value of Land and the Agricultural Crisis

Classification according to the system of farming and the situation in regard to markets does not alone portray the conditions under which agriculture is pursued. Some expression is needed by which the success of farming in the various zones may be measured. Such a general economic designation is the assessed value. The revenue department has created a measure in the unit value (Einheitswert) of agricultural enterprises, by which the permanent income value (nachhaltigen Ertragswert) in Reichsmarks per hectare may be expressed for the total area of the farm.[1]

Figure 5 presents the unusually great difference in farm values in Germany. If this map is compared with the agricultural regions of Figure 3, it may be seen that the regions with high tax values coincide to a large degree with Regions 4 and 5 and the coastal strip of Zone 1a. These regions with values of more than $133 an acre—increasing here and there to $300—are exclusively those with good loam and loess soils or with a vine climate. From the standpoint of world economics they belong to the most highly developed regions. The rich pastures

[1] The unit value has been obtained by multiplying by the capitalization factor 18 the computed yearly earnings presumably obtainable in the long run. This factor corresponds to a rate of interest of 5½ per cent. In reality the rate of interest in Germany has always been much higher. The factor 18 therefore is very unfavorable to the farmer, and the value thus obtained is in many cases higher than the actual earning. Consequently many farmers have to go into debt to pay their taxes. Under "net income of a farm" the revenue offices understand the income from operation minus all expenditures, the pay for labor by the farmer being considered among the expenditures. From the net income the farmer has to pay the interest to his creditors and the taxes to the state. The rest represents the interest on his own capital.

of the North Sea coast are famous in the pastoral world. The farmers of Zone 4 have a very intensive system of agriculture and are completely capitalized; they have yearly turnovers such as are hardly anywhere else obtained in the agricultural districts. The development of urban life early led to the horticultural use of the loess-covered slopes and hills of the upper Rhine lowland and the Neckar basin. Every small piece of land is tied up with the urban commercial mechanism in regard to its profits and its value as real estate.

The regions with low tax values are in the rye-potato Zone 3 and in the worst parts of Zones 1 and 2. These extensive regions with a tax value of less than $48 an acre are exclusively sand, forest, moor, heath, or mountain. The land tolerates the peasant, if he is adaptable; agricultural development is confined to the system of improved three-field farming characterized by rye, oats, potatoes, and unexacting pastoral industry. The few railroads and the scanty net of highways afford incomplete connection with the major systems of economic circulation. But for the old peasant virtues, frugality and stability, such regions would have been lost to agriculture and rural life.

As a result of the acute crisis which started in 1929 a serious disproportion has arisen between the assessed value and the income. Most of the farmers are in debt, and especially among the large farmers of eastern Germany there are many whose debts are higher than the assessed value of their farms. But the agrarian crisis has brought the farmers of all regions into difficulties. We emphasize with the aid of Figure 5 some of the outstanding facts.

Reference has already been made to the present plight of the livestock farmers of the North Sea Marschen, many of whom have gone bankrupt. The situation of the farmers in the remaining part of Zone 1a is determined by the prices for hogs, butter, and breeding cattle. Here exists a cycle of hog prices similar to that in the corn belt of the United States: years of good income alternate with years in which the farmer suffers losses. But as compared with the one-system farming of the Marschen the diversified farming on the sandy Geest has the advantage, and here farm indebtedness is less.

In Zone 1b the crisis is most severe in the eastern part which is far from the markets. Here the large farms of more than 1000 acres were especially hard hit, in the first place on account of the high interest charges for business credits. In East Prussia there is the additional drawback that it has been cut off from the rest of the country by the Polish Corridor and thereby has lost a part of its earlier market region. Many estates have been bought up by settlement associations and laid out in small farms. The crisis in Zone 3 has had a similar effect. Here it is a matter not only of a crisis in farm property but a threat to rural life as a whole.

Many sandy soils were first cultivated during the rising market

of the pre-war period, when Germany had much capital, low taxes, and a flourishing industry. Today a part of this marginal land must again return to pasture and forest, a development such as commenced years ago in certain parts of the United States. In Germany, however, the farmers do not forsake the land of their own free will: they maintain themselves by the labor of their families and the great lowering of their standards of living. Tariffs have prevented a complete breakdown up to the present time. Since 1929 the east German regions have been supported by a series of emergency measures (lowering of the rate of interest, conversion of short term credits into long term credits, and partial cancellation of debts), without a turn for the better having as yet commenced.

For the mountainous parts of Zones 1c and 2 the situation after the war was the worse, in that trade increasingly hinged on the turnover in standard products. The mountain peasants grow a great variety of crops and live far from the markets; furthermore they are unfamiliar with the market situation, and only have salable products from time to time. Lacking a steady connection, they can command only very low prices. For the many small farmers who, on account of the closing down of industrial plants, have lost their major or supplementary source of income, it has been even worse since 1930–1931. In many mountain villages a proletariat has arisen that, no longer able to find support on the product of the small potato patches, must draw unemployment compensation.

Two circumstances depress the prosperity of the farms in the grain-sugar beet Zone 4, competition in cane sugar and the high interest on borrowed capital. On the basis of international agreements the sugar-beet areas had to be decreased, so not only has the monetary income of the farmers diminished but also the valuable wastage from the sugar-beet cultivation no longer is available for the cattle. The high interest rates hit particularly the large capitalistic farm establishments that cannot operate without large business credits.

This is also true to a considerable degree of the farms that engage in an intensive hog and poultry business with purchased feed. The decrease in the purchasing power of meat and eggs and the increase in the cost of feed because of measures taken for the protection of grain farming have caused these farmers great losses. Especially hard hit were the parts of Zone 1a in the vicinity of Hamburg and Bremen.

In the remaining regions with average farm values and diversified farming the existence of most of the peasant farmers has not yet been directly threatened, although their debts have greatly increased in the years 1930–1932; they endeavor to lower production costs and, if that is no longer possible, to cut down still further the standard of living. The German farmer is ready to make the greatest sacrifice for the soil that has been in the possession of his family for generations.

AN EXPERIMENTAL AIR NAVIGATION MAP

O. M. Miller

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[With separate map, Pl. I, facing p. 56]

MAN has been walking and running about on the face of the earth for a good many thousands of years. The airman, having been sufficiently unconventional to take to wings, supposedly will not be hidebound to convention as regards the maps he uses. He will not insist that old conventions be employed just because as landsman or seaman he has become accustomed to them: rather will he realize and rejoice in his freedom from the need of translating the vertical view into terms of horizontal perspective.

To discuss new types of maps meeting the requirements of aviation the American Geographical Society towards the end of 1929 called a conference attended by experts from government departments and representatives of leading aviation companies.[1] It was then decided that the Society, as an independent research institution free of limitations necessarily imposed on government bureaus and commercial organizations, might usefully undertake work of experimentation, producing a map to serve as the basis for constructive criticism. This map is now presented as Plate I, facing p. 56, "Experimental Air Navigation Map of the Pittsburgh-Cleveland Area."

The area chosen for the map lends itself well to the purposes of the experiment. It includes the most heavily industrialized section in the United States and part of the sparsely populated uplands of western Pennsylvania. It affords strong contrasts and much varied detail. It is well known by most airmen and is of particular interest to them, as most of the important air routes of the country converge here.

Convention and Map Symbolism

At the outset a word must be said about map convention in general. Once a map convention has been established it is difficult not to feel prejudiced in its favor. A curious example is the convention that, in showing relief by hill shading, shadows must fall to the southeast. If one turns such a map around, one is likely to see the hills and ridges as depressions. Yet this is a man-made map convention, and there is no obvious natural cause for the illusion. The trouble is that until recently man has not been accustomed to viewing things from

[1] Conference on Air-Navigation Maps, *Geogr. Rev.*, Vol. 20, 1930, pp. 148–149.

above. His line of vision has usually been directed horizontally, and the light causing shadows in his field of view probably has come from one side and from above.

The sun is close to the horizon, and the deep valley is cast in shadow. One looks towards the hills still bathed in sunshine. Light hills, dark valleys, and yet the map convention denoting relief by hypsometric tints shows highest land the deepest color and lowland the lightest. However, when green is added to show the lowest of lowland, the order, to avoid abrupt contrast, is reversed, and the darkest green represents sea level or thereabouts. One is reminded of a landscape in which the warm colors and deep shadows are in the foreground with the cool greens, grays, and blues in the distance, or again, of green fields in the valleys and autumnal tints on the hills. Yet this symbolism, so agreeable to the dweller of the rainy temperate lands, is annoying to the Egyptian, for instance, who resents a map showing much of the Sahara Desert tinted a lush green. Nor is it particularly appropriate to an airman's point of view, no matter what his country, for such is the speed of air travel that in a very short time he may pass from a moist temperate climate to an arid one.

Now there are objects that can be represented on a map only symbolically, regardless of shape or color. This is where convention is useful and important. The map reader has to learn to recognize the shape of the symbol; and, once a good convention has been adopted, it should not be lightly changed. For instance, the air maps of the Department of Commerce have a system of circles to denote different kinds of airports. There is no point in devising new symbols for these. They might have been squares or they might have been triangles, but in any case they do not indicate the true shapes of the airports. On the other hand, a line on a map is not purely a symbolical representation of a line in nature. It has a graphic resemblance, and its nature can be recognized from its shape and character without the aid of color, and the precision obtainable in graphically representing the true shape and dimensions of such a feature in the landscape is dependent largely on the scale of the map.

Classification of Air Maps by Scale

An airman has many diverse uses for maps which cannot all be adequately taken care of on any one scale. For instance, if he requires a great amount of detail, the map must be on a scale not much smaller than 1:500,000. Even on this scale it is impossible to show all detail accurately. However, if he should decide on a larger scale, he is up against the difficulty that any sheet small enough to handle conveniently while flying takes in an area so small that it can be crossed in a short time, with the result that many sheets must be carried in making a long-distance flight.

As a result five different types of map useful to airmen have come into existence, and examples of each have been published in various countries.[2] These types can be classified as follows:

1. General maps on scales less than 1:5,000,000 for planning long flights.
2. Small-scale charts on scales between 1:1,000,000 and 1:5,000,000 for strictly navigational purposes on long-distance flights.
3. Route maps for piloting purposes on scales between 1 : 200,000 and 1 : 1,000,000 with as much pertinent detail on them as the scale will allow.
4. Local maps showing vicinities of airports on scales from 1:20,000 to 1:300,000.
5. Large-scale plans of airports.

Principles Governing Selection of Symbols

The American Geographical Society's Experimental Air Navigation Map is of the third type and is on a scale of 1 : 500,000. An airman may use a map of this type in at least four different ways: primarily for finding his way from one place to another, for information as to flying facilities along his route, as to the degree of safety he may chance making a forced landing, and finally to help him locate himself if he gets lost or comes down from above clouds. As regards this last, no matter how good a map may be, it is largely a question of luck and circumstances as to whether the airman on seeing suddenly a small section of country below him can immediately identify it or not. If he is in a region of some contrast, a map showing the pattern of features or the relationship between features or the predominance of one over another will give the character of the locality which may be just the confirmation he needs to give him faith in his compass and his dead reckoning or astronomical position-finding observations.

Natural features, such as drainage pattern and relief, lines of communication, such as roads, railroads, high-power transmission lines, extraordinarily conspicuous landmarks, artificial or otherwise, built-up areas, and other features dangerous to flying and facilities for flying must all be shown on a map of type 3. Each is of importance; and, though in some regions one type predominates, it is essential that each type be clearly differentiated from the others. Accuracy as to form and clearness, so that the airman can see at a glance the class of information he requires, are the essential elements of a good air map, and it would seem that the primary use of color should be to help towards these ends by showing the different types of information in violent contrast to one another. The association

[2] See the appendix to this paper.

of ideas connected with the actual color of the object to be represented becomes of secondary importance, only to be considered when not conflicting with the first. It is with these principles in mind that the system of representation of the experimental map has been devised.

Physical Features

As a means of finding his way, the most important physical feature to the airman is the drainage system. The type of drainage, such as the absence or presence of large rivers, the general direction of the flow, etc., also helps to identify a region. Consequently all water is shown as white against a background of gray; and white is the exclusive property of water, as all other features are printed in black or colors.

Information in respect to relief falls into three categories. First, the relative differences of level, whether the country is mountainous, hilly, or flat, maturely or immaturely dissected. Second, the absolute heights of the terrain for purposes of making safe landings and clearing obstacles in the line of flight. Third, the conspicuous relief features, which help the airman in identifying his position.

Relative differences of level are shown by hypsometric tints of gray, each tint representing a 500-foot range in altitude. As the principal drainage is in the lower part of the terrain, the darkest tint indicates the lowest ground, the lightest tint the highest ground. This is contrary to usual practice; but in the author's opinion, as already suggested, it is really the most natural as far as air maps are concerned. The choice of a neutral color for the hypsometric tints leaves a range of bright colors available for the symbols and affords a background against which they are all the more conspicuous. By this system of white drainage and gray tints for relative differences of level the number of plates necessary for printing the map has been reduced.

To show absolute heights on the map a new system of spot heights has been developed, these being very carefully chosen to show the highest and the lowest points respectively in any small area, black spot heights being high and the white spot heights being at water level. This does not mean that over the whole map all black spot heights are higher than all white spot heights. The airman in determining at what height to fly in order to clear obstacles should study the black spot heights, but in looking for a place to land he should take the white spot heights into consideration as well. The heights of all airports are shown in black but are distinguished from the general spot heights by being smaller and sloping in character. Relief features such as sharp peaks and bold escarpments are shown in black hachuring but only when from actual observation they are known to be extremely conspicuous objects in the landscape. Instances on the Pittsburgh-

Cleveland map are to be found in the gorges of the deeply entrenched Allegheny and its tributaries.

It should be noted that with this scheme information in respect to absolute heights is very well taken care of by the system of spot heights. Consequently the hypsometric tints are only required to give an immediate picture of the relative differences of level. As only one color is used in printing the tints, the mind is not prejudiced as is usual with hypsometric tints in associating particular colors with absolute heights, and each sheet of a series can therefore be treated as a unit in itself and the optimum gradation of tints can be chosen in each case. This does not imply changing the contour interval from sheet to sheet. For instance, on a sheet where the maximum range in height is nowhere more than 500 feet, there would be no point as far as the airman is concerned in showing 100-foot contour intervals. One tint or at most two gradations would be better than many in this case, as the comparative flatness of the region would then be well demonstrated. However, in choosing the intensity of the tints, consideration would be given to those which would show the colored symbols to best advantage; and, in the case of two or more gradations being used, the contrast should not be the maximum possible but just that sufficient to show distinctly the required relationships.

When the research was started, it was hoped to be able to find some formula whereby it would be possible to classify the terrain into regions safe, dangerous, and impossible for making a forced landing. However, it was soon realized that the height of the flight, size and speed of the aircraft, and weather conditions were factors that predominated in the question and that they could not be taken into account on a map. In addition, the individual pilot prefers to make his own decision as to the risks he is incurring, as these are after all a matter of opinion and what he requires in the map is the information that will enable him to make up his mind under any of innumerable combinations of conditions. Consequently, the only general classification of land areas attempted has been brief descriptive titles, such as "forested uplands," "cultivated valleys," written across the area in large, fine black letters. No attempt has been made actually to define the boundaries of these areas, for they are intended simply for the airman's general information preparatory to making a flight.

Lines of Communication

It was decided after much consideration that, as far as it was possible to obtain the desired information, all improved roads and railroads should be shown on the map except in urban areas. This conclusion has been reached in the full realization of the difficulty of representing these features clearly at a scale of 1:500,000 in densely settled regions.

As a general rule, railroads are the easiest lines of communication to pick up and follow in flying, but this is not always the case. Badly maintained single-track railroads are often extremely difficult to see, especially when one is flying high. In mountainous country the railroads generally follow the tortuous routes along the sides of the rivers, and the highways are the more conspicuous, easier to pick up, and more direct to follow. In addition, the pattern of the highway network is an indication useful in identifying a region. This is clearly shown on the experimental map. In the Cleveland region the highways are for the most part in north-south and east-west directions, the rectangular pattern of the Middle West, and their network gives a reliable guide to direction. The through highway of this area running diagonally across the old rectangular system becomes a conspicuous landmark. In the southwestern corner of the map the road pattern gives an entirely different impression conforming to the broken and hilly topography. In the northeastern part of the map the roads few and far between are indicative of the mountainous and undeveloped nature of the countryside.

In compiling the experimental map great care has been taken to represent the curves and twists of the roads and railroads as accurately as possible, as it has been found by experience that generalization to any great extent leads to confusion in identification. For instance, in hazy weather an airman sees on the ground a conspicuous V breaking the straight-line continuity of a road. If this is not shown on the map he may begin to doubt his judgment as to his position.

Improved roads are shown by a thin green line printed over the gray. Steel-tower power-transmission lines are shown in unbroken red lines dotted at intervals and also printed over the gray. Railroads are shown in black conventionally as far as single-track lines are concerned. Double tracks or more are so much more conspicuous than single lines that it has been felt necessary to differentiate clearly between the two, and consequently a symbol has been chosen for double track often used on European maps for railroads. It is noted, however, that in America there is a prejudice against this symbol as it was used in the past for canals.

Features Dangerous to Flying and Flying Facilities

Red has been used exclusively for showing artificial objects that are dangerous to flying, and this of course includes built-up areas. A new symbol has been introduced to represent suburban areas, small villages, and scattered groups of buildings, as it has been found to be more effective than the conventional dotting or shading.

Extraordinarily conspicuous landmarks are shown only when from actual knowledge they constitute a dominating feature of the land-

scape. The representation of prominent relief features has already been dealt with. It was difficult, however, to prescribe a readily recognized system of symbols that would cover all types of conspicuous objects. For instance, it was not possible to show the huge Goodyear Zeppelin hangar south of Akron, Ohio; but it is quite important to indicate it. Consequently, as such features are few and far between, they are sufficiently indicated by a dot or dash for position and by naming them in very small black type.

The system of symbols representing airports, lighted beacons, lighthouses, and other facilities for flying are the same in general character as those adopted by the U. S. Department of Commerce. They are, however, printed in black with yellow centers.

Aids to Navigation and Names

Aids to navigation as distinct from information for piloting purposes have been kept purposely off the main map. Instead of a compass rose, a marginal protractor is provided. Marginal scales with miles are shown in such a way that they are easily read, no matter in what way the map is being looked at. A small key map on a much smaller scale and covering a much larger area has, however, been included. This also has a marginal protractor. Magnetic declination is shown in red, and meridians and parallels are drawn at 10-minute intervals.

All airports are named in black. The names of towns and cities are in red. Generally speaking, only those with more than 5000 inhabitants have been named, though exceptions to this rule occur in the sparsely populated sections. All other names except those of a few prominent rivers and other very conspicuous features are omitted.

Many small towns have their names printed conspicuously on some roof in the area. However, it has been found impossible to obtain accurate information on this matter, and it is doubted whether these names are of much assistance to the airman except when he is flying over a familiar route. It is suggested that it would be far more effective in the case of small towns if local authorities would paint on prominent roofs such information as, for example, "40 miles to Cleveland" with an arrow pointing in the direction.

Map Projection

As the primary object of the research was the selection and representation of detail for the air map, and also because the map was an experiment and not intended to be one of a series, the choice of map projection was more a matter of convenience than anything else. The modified polyconical projection of the International Map on the scale of 1:1,000,000 was used, as the tables for its construction were readily available. Over such a small area as is represented by the

experimental map there is little to choose between it and the Lambert's conformal conic as used as a base for the Department of Commerce sectional air maps. Both show little variation in scale over large areas, and both show the great-circle courses as approximately straight lines, sufficiently straight at any rate for navigating purposes. It should be noted here, however, that there are two distinct schools of thought on the subject.

The International Commission for Air Navigation has decided that all air maps should be based on the Mercator's projection, which has, of course, the property not had by any other projection that the rhumb-line course is represented by a straight line. This, however, is no longer the advantage it was. In planning a long flight over land the procedure is generally to draw on a small-scale map the most convenient route. Points at suitable intervals are selected along the route, and these points are connected by great-circle courses on the small-scale map. Provided the distances from point to point are not more than a few hundred miles, then the mean azimuth of the great-circle course will probably not differ from the rhumb-line bearing by as great an amount as the error the pilot will incur in setting his plane on a predetermined course. In addition, with the advent of radio beacons as aids to aerial navigation, the importance of representing great-circle courses by straight lines on the map has greatly increased. The great disadvantage of the Mercator's projection is the variation in scale.

Steps in Compilation

As a preliminary to the compilation of the map the author spent some time familiarizing himself with the appearance of the earth as seen from the air. He made a number of flights including one across the continent and, with the task of compiling the map constantly in mind, was able to see the point of view of the inexperienced airman using a map for finding his way across new country. This seemed just as important as getting the various expert opinions of airmen of long experience. The latter, however, were not neglected.

The actual compilation of the map turned out to be a long and arduous task, and much credit is due Mr. John Forsyth who executed the greater part of the work under the author's direction. As regards the physical features it was compiled as far as possible from the topographical sheets of the U. S. Geological Survey. As most of these sheets were published some time ago, such information as recent changes in roads, railroads, extensively built-up areas, airports, reservoirs, etc., had to be sought elsewhere. A certain amount of information was obtained from Department of Commerce maps and various state maps. In addition, county and city engineers were asked to supply the latest information on their regions, and many replied fully

and adequately. Power and light companies and the oil companies, also requested for information, responded obligingly in most cases. But in spite of the care taken, it was felt that the data were of unequal reliability. The practical remedy for this was the checking of compilation by actual flights in the field before the printing of the map. Mr. G. A. Thorne generously lent his services and his airplane for this purpose. He flew the compiler in the fall of 1930 and again in the spring of 1931 over large sections of the area. The flights were arranged so as to cover the ground in parallel and transverse strips. In addition, his advice has been of great assistance.

We shall conclude the introduction to the Society's Experimental Air Navigation Map with a word of self-criticism and an invitation to further criticism on the part of readers of the map whether on the ground or in the air. As must be expected in an experiment of this sort, the first result is by no means free from imperfections in execution, and there are several details of representation that would be improved in a new edition of the map or in the making of another sheet. For example, the symbol representing suburban areas and small towns is not sufficiently emphasized to be clear at first glance, and the same criticism applies to the lettering of the physical classification. Certain of the more prominent roads might well be emphasized. The black star symbol representing a light beacon should be changed, for on the present map those airports having lighting facilities do not appear as bright as those having none, the reverse of the effect desired. The choice of gray tints on the key map was not the happiest, and it would have been better perhaps if the shore lines of seas and lakes had been outlined in black. The real test of the map, of course, lies in its actual use, and the Society will especially welcome any commentary thereon.

APPENDIX: RÉSUMÉ OF AIR MAP RESEARCH

As the history of air map research goes back so short a time it may not be out of place to give a brief outline of its progress.[1] The first time that the need for an air map was discussed in print was as far back as 1888. Lieutenant Colonel H. Moedebeck in the *Zeitschrift für Luftschiffahrt*[2] made the suggestion, and, as far as can be ascertained, the first attempts to construct a map exclusively for flying purposes were made in France in 1911. There were two series, viz., the "Carte Aéronautique," published by the Service Géographique de l'Armée, and the "Carte de l'Aéro-Club de France," published "sous le haut patronage et avec le concours du Ministère des Travaux Publics." They were both on a scale of 1:200,000, and even the first sheets were very carefully thought out as regards symbols. Also, at first, much attention was paid to the exaggeration of detail, such as the thickness of roads,

[1] A fairly full bibliography on the subject of air maps was published in *Geographisches Jahrbuch*, Vol. 46, 1931, pp. 33 and 109–110. Reference may also be made to two articles in the *Geographical Review*—O. B. Whitaker: Aëronautical Charts, Vol. 4, 1917, pp. 1–5; H. Woodhouse: Aëronautical Maps and Aërial Transportation, *ibid.*, pp. 329–350. The *Annuario della Aeronautica*, 1932, published by the Italian Touring Club and the Italian Royal Aero Club gives a very full account of air map activities throughout the world.

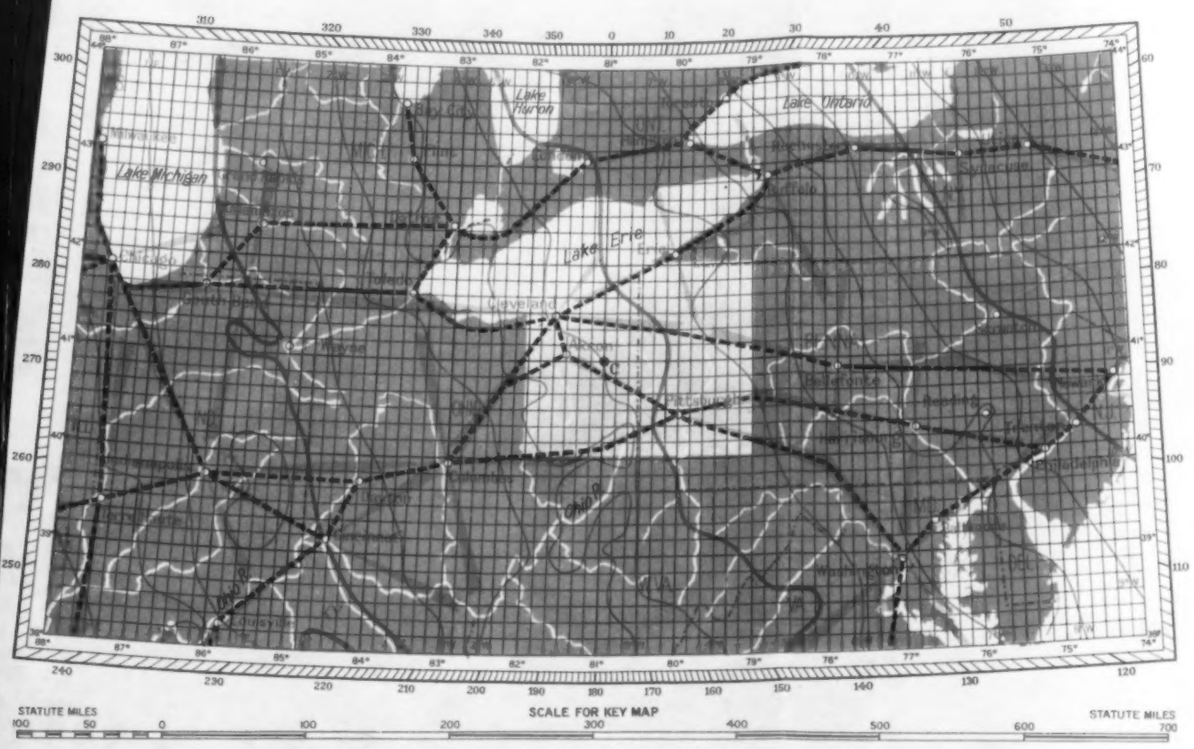
[2] Karl Peucker: Luftschiffahrtskarten, *Geogr. Zeitschr.*, 1908, pp. 614–617.

EXPERIMENTAL AIR NAVIGATION MAP
OF THE
PITTSBURGH - CLEVELAND AREA

COMPILED AND DRAWN BY THE
AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK

1932

Scale of main map 1:500,000 Scale of key map 1:7,500,000



The main map is drawn on the modified polyconical projection as adopted for the International Map of the World on the scale of one to a million. It covers a section of sheet North K 17 of the International Map, and the area represented was chosen rather for its general interest than to conform with any system of subdivision of the international series. The key map is an extension of the same projection.

Meridians and parallels have been omitted from the main map but are drawn at ten-minute intervals on the key map.

Lines of equal magnetic declination are shown in red on the key map only, but the approximate magnetic bearings of the lighted airways are indicated on the main map. Only lighted airways are shown on either map.

The protractors on both maps are centered ("C" on map) from the same geographical position, namely, lat. 41° N., long. 81° W. To obtain the true bearings of a course on either map draw a line parallel to the course through the protractor center and note the protractor reading. This will give the true bearing of the course where it cuts the central meridian. The true bearing of the course at any point east or west of this can be deduced with sufficient accuracy for navigational purposes by adding if east and subtracting if west to the protractor reading two-thirds of the difference in longitude.

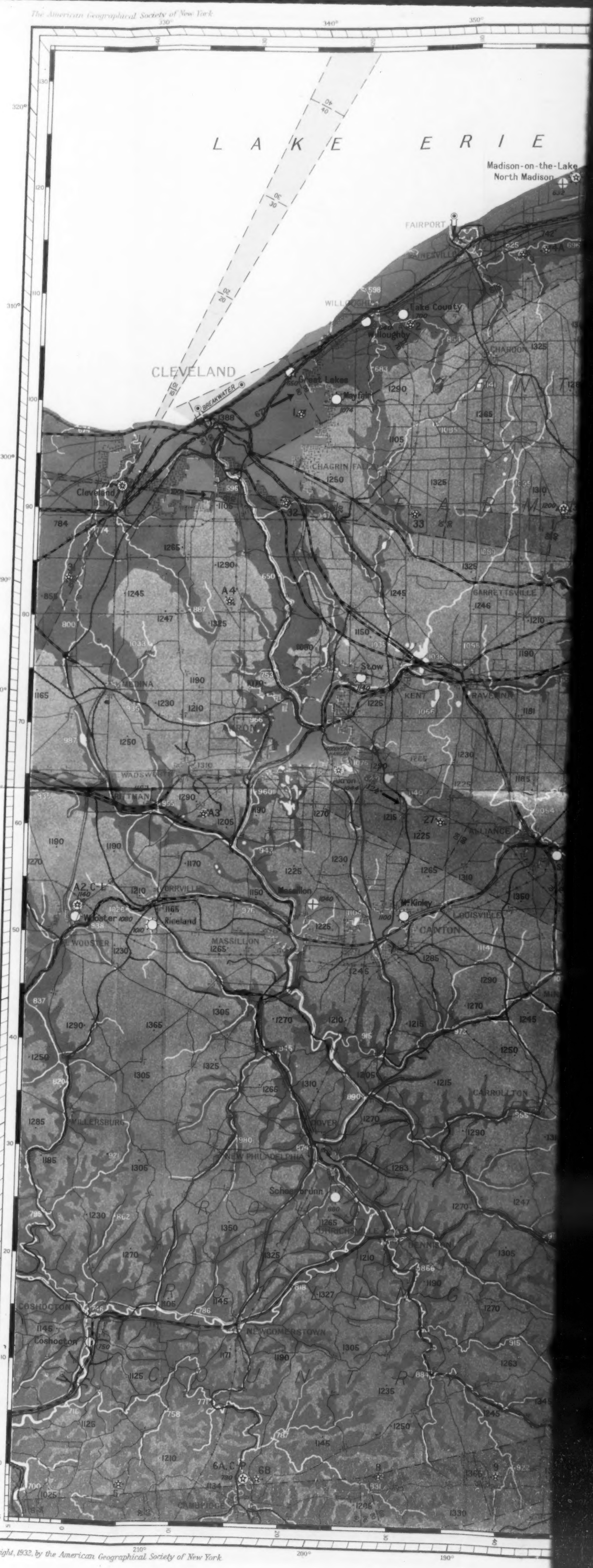
Attention is directed to the system of spot heights, which have been very carefully chosen with a view to showing the relative differences of level in any part of the main map. The black and white spot heights show the highest and the lowest points respectively in any small area, but this does not necessarily mean that over the whole map all black spot heights are higher than all white spot heights. The air navigator in determining at what height to fly in order to clear obstacles should study the black spot heights, but in looking for a place to land he should take the white spot heights into consideration as well. The heights of all airports are shown in black but are distinguished from the general spot heights by being smaller and sloping in character.

KEY TO SYMBOLS USED ON MAIN MAP

Large cities	CLEVELAND
Medium sized cities	NEWCASTLE
Small cities	INDIANA
Airports	Franklin
Rivers	*Ohio R*
Mountain ranges and peaks	*Laurel Hill*
Other named features	GOODYEAR HANGAR
Physical classifications	FARMLAND
High spot heights (in feet)	1326
Low spot heights (in feet)	1326
Heights of airports (in feet)	776
Drainage	
Escarpments and prominent peaks	
Fully built up areas, cities etc.	
Suburban areas and small towns	
Oil tanks, each dot denotes 50 tanks, five dots denote 250 tanks or over	
Docks	
Lookout towers	
Roads	
Railroads, three or more tracks	
Railroads, two tracks	
Railroads, single track	
Railroads, electric	
Railroad yards	
Power transmission lines	
Army, Navy or Marine Corps airports	
Commercial or Municipal airports	
Department of Commerce intermediate fields	
Marked auxiliary fields	
Airway light beacons, rotating, arrows indicate course lights	
Auxiliary airway light beacons, flashing	
Airport light beacons with code light	
Lighthouses	
Radio beacon zones, small arcs indicate mileage from transmitting stations	615
Magnetic bearings along lighted airways (approximate)	268°

Feet
2500
2000
1500
1000
500

The American Geographical Society of New York



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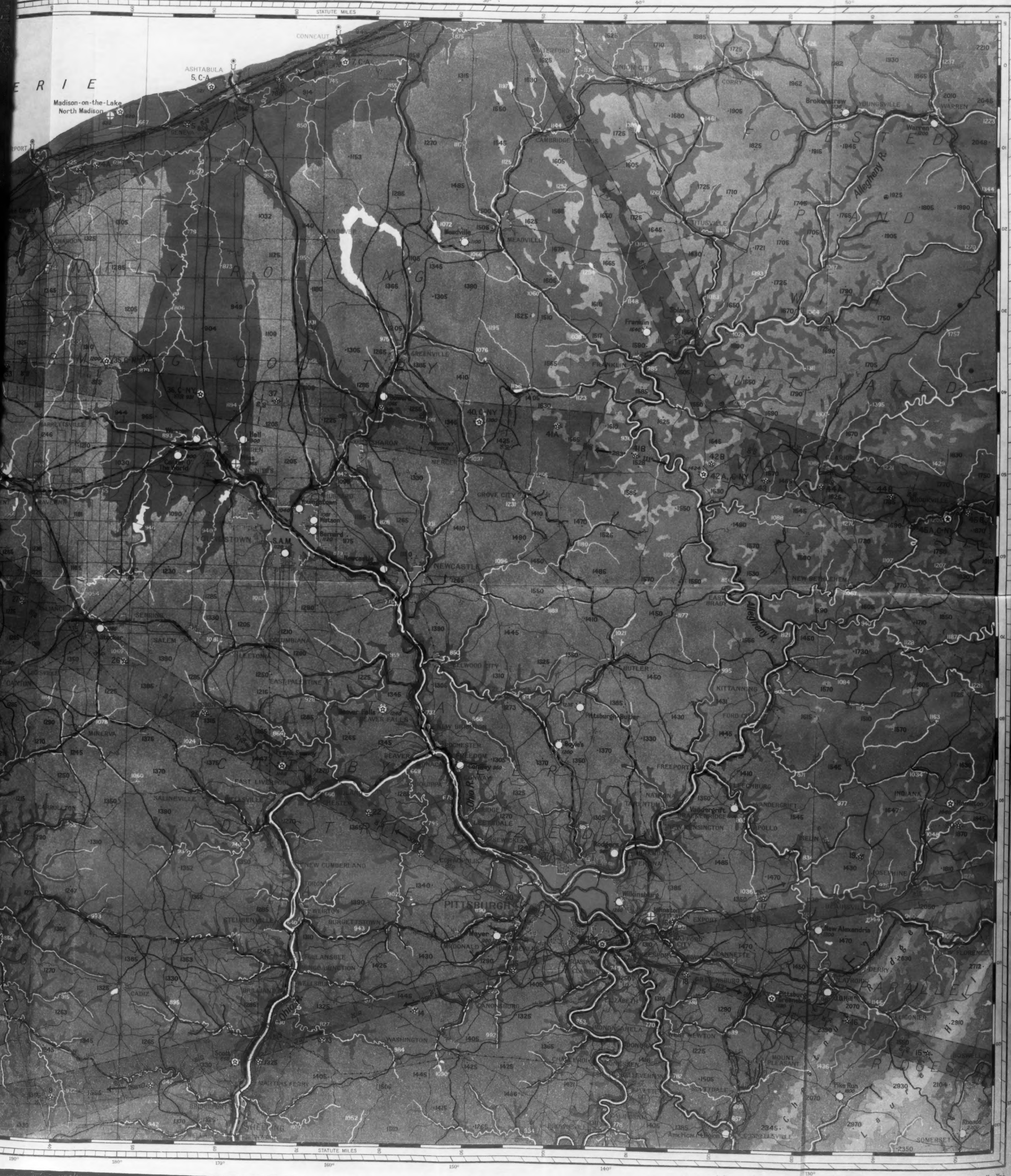
STATUTE MILES
CONNEAUT
ASHTABULA
Madison-on-the-Lake
North Madison
ERIE
MAHONING COUNTY
TRUMBULL COUNTY
MERCER COUNTY
LAWRENCE COUNTY
BEAVER COUNTY
ALLEGHENY COUNTY
WESTMORELAND COUNTY
WASHINGTON COUNTY
FOREST
CLARION
JEFFERSON
ARMSTRONG
INDIANA
CAMBRIA
SOMERSET
BEDFORD
FULTON
FRANKLIN
Youngstown
Warren
Sharon
Newcastle
Meadville
Franklin
Oil City
Titusville
Brookfield
Kinsman
Mineral Ridge
Niles
Girard
Hubbard
Canfield
Poland
Struthers
Lowellville
Ellwood City
Butler
Kittanning
Pittsburgh-Butler
Beaver Falls
Rochester
Aliquippa
Conway
Freeport
Leechburg
Vandergrift
Apollo
Kiskiminetas
Wilkinsburg
Pittsburgh
McKeesport
Monongahela
Canonsburg
Washington
Bridgeville
Carnegie
Mount Pleasant
Scottdale
Connellsville
Uniontown
New Alexandria
Latrobe
Derry
Greensburg
Irwin
North Huntingdon
Export
Murrysville
Delmont
Pittsburgh-Greensburg
Pike Run
Rhoads
Somerset
Allegheny R.
Ohio R.
Monongahela R.
Youghiogheny R.
Kiskiminetas R.
Conemaugh R.
Laurel Hill
Chestnut Ridge
Allegheny Mts.
Ligonier Valley
Laurel Hill
Ligonier
Loyalhanna
Blairsville
Indiana
Clymer
Barnesboro
Ebensburg
Carrolltown
Loretto
Cresson
Gallitzin
Hollidaysburg
Bedford
Everett
Rainsburg
Mann's Choice
Fishertown
Saxton
Broad Top City
Mount Union
Huntingdon
Shade Gap
Fort Loudon
Mercersburg
Chambersburg
Greencastle
Waynesboro
Quincy
Fayetteville
Scotland
Gettysburg
Hanover
Littlestown
Fairfield
Emmitsburg
Thurmont
Frederick
Middletown
Boonsboro
Hagerstown
Williamsport
Clear Spring
Cumberland
Frostburg
Lonaconing
Westernport
Piedmont
Oakland
Grantsville
Accident
Deer Park
Friendsville
Kingwood
Rockwood
Somerfield
Meyersdale
Salisbury
Berlin
Jennerstown
Stoystown
Hooversville
Windber
Portage
Patton
Carrolltown
Ebensburg
Barnesboro
Spangler
Nanty Glo
Vintondale
Cresson
Gallitzin
Tyrone
Bellwood
Hollidaysburg
Altoona
Duncansville
Roaring Spring
Martinsburg
Hollidaysburg
Huntingdon
Mount Union

and to devising symbols for such conspicuous objects in the French landscape as chateaux. Later the Aéro-Club de France brought out a much improved and very beautiful "Édition de la Guerre," in which the detail was much more delicately reproduced. Other European countries have for the most part contented themselves as regards air maps in overprinting their standard maps with information as to air facilities.

The first strip route maps were compiled by the Italian government[3] during the war on a scale of 1:250,000, and in 1924 and 1925 this government issued 53 sheets of a map on the scale of 1:300,000 which completely covered the whole of Italy. Though this map was based on a general map previously published by the Italian Touring Club, and was not sold to the public, nevertheless the claim that it was the first complete air map of a country is probably justified.[4] In 1923 the United States Government started issuing strip maps on a scale of 1:500,000. A series of provisional sheets entitled the International General Aëronautical Map, on scales varying from 1:2,186,607 to 1:3,530,260, depending on the latitude, for the map was on the Mercator's projection, also began to appear at this time. These latter sheets covered large parts of Europe, northern Africa, and southwestern Asia. Some of the sheets were published by the Service Géographique de l'Armée, of France, while others were published by the British Air Ministry. Both showed elevations by hypsometric tints; but the latter, in addition, distinguished between cultivated or wooded land and arid land by using different colors for the hypsometric tints over these areas. The result was pleasing and effective.

In Canada, the Geographical Section of the General Staff of the Department of National Defense have issued strip maps of the Detroit-Toronto-Montreal-Quebec Airway. These maps are generalizations from the standard 4 miles to 1 inch map of Canada. Recently they have issued one sheet of an aeronautic edition of this map on which little generalization has been made but on which flying facilities have been superimposed in red. The Topographical Survey of Canada has also issued several strip maps. These are notable for their clearness and distinctive coloring. Black, blue, red, orange, and green lines stand out well against an almost pink background.

Since 1930 the Department of Commerce has issued several sheets of its sectional air map of the United States,[5] and it should be noted that as each succeeding sheet appears it seems to be superior to the preceding one in its manner of representation and reproduction. In style these new sheets are the obvious offspring of the old strip maps, but effective innovations are being gradually introduced.

In the *Official Bulletin No. 19* of the International Commission for Air Navigation published in October, 1931, Annex F is devoted to the subject of air maps. It is stated therein that a further study is being made but that at present two types of maps are recommended, a general aviation map on a scale of 1:1,000,000 and a local map on a scale of 1:200,000. Both maps are to be on the Mercator's projection, but otherwise the colors, symbols, and arrangements for production adopted for the International Map on the scale of 1:1,000,000 are to be used as far as practicable for the general map, except, of course, for special features showing flying facilities. A recommendation is made "that steps be taken to survey from the air the areas along the most important international routes. Such surveys would furnish indispensable information regarding the features necessary to be shown on the maps the aviator is to use."

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[3] *Geogr. Rev.*, Vol. 4, 1917, p. 333.

[4] See *Annuario della Aeronautica*, 1932, published by the Italian Touring Club, p. 976.

[5] Air Navigation Maps, *Aeronautics Bull No. 10*, U. S. Dept. of Commerce, Aeronautics Branch, 1932.

Raymond L. Ross: The United States Sectional Airway Maps, *Military Engineer*, May-June, 1932, pp. 273–276.

LIST OF AIR MAPS

Group 1: General Maps for Planning Long Flights

SCALE	COUNTRY	DATE	REMARKS
1 : 31,000,000 Scale of projected sphere	WORLD	1929	Grösstkreiskarten für Luftnavigation. Deutsche Seewarte, Hamburg. Gnomonic projection. Sheet 1: North Polar Chart, 2: North Atlantic Ocean, 3: South Atlantic Ocean, 4: Europe and Asia.
1 : 17,500,000 Equidistant zenithal projection	UNITED STATES	1928	Navigation and radio beacon chart, showing great-circle distances and azimuths from Wright Field. Instrument and Navigation Unit, Washington, D. C.
1 : 1,000,000 to 1 : 5,333,000	EUROPE	1927	Grosser Luftverkehrs-Atlas von Europa. These are route maps for planning flights rather than navigational maps.

Group 2: Small-Scale Charts for Navigational Purposes on Long-Distance Flights

1 : 3,700,000 Approximate scale of projected sphere	WORLD		International general aeronautical map (*Provisional*), Mercator's projection.
		1923	8 sheets by British Air Ministry,
		1923	9 sheets by Service Géographique de l'Armée française,
		1929	1 sheet by Ministry of Communications, Warsaw, Poland.
1 : 1,360,000 Approx. scale of projected sphere	FRANCE	1928	Cartes aéronautiques, Service Hydrographique de la Marine, Paris. Mercator's projection. 12 sheets. Sections of French coast line showing positions of lighthouses.
1 : 1,459,200 Scale at latitude 40°	UNITED STATES	1932	Flight service map. Mercator's projection. 21 sheets. Pilots' Handbook Publishing Co., Los Angeles, Cal.
1 : 1,100,000 Scale of projected sphere, approx.	UNITED STATES	1932 Oct.	Naval Aviation Chart (1 sheet). New York-Washington-Pittsburgh. Hydrographic Office, Washington, D. C. Mercator's projection.
1 : 1,000,000	UNITED STATES	1932	Night-flying maps on back of revised edition of Army Air Corps strip maps. Sheets Nos. 29 and 39.

Group 3: Route Maps for Piloting Purposes

1 : 800,000	GERMANY	1929 (?)	Strechen-Karte. Deutsche Luft-Hansa, Berlin.
1 : 750,000	CZECHOSLOVAKIA	1929	Carte Aéronautique d'ensemble de la République Tchécoslovaque (in 2 sheets with insets). Shows established commercial routes and "corridor aérien" in and out of the country.
1 : 500,000 to 1 : 1,000,000	UNITED STATES	1930	Air trails maps of individual states. Rand McNally & Co., Chicago.
1 : 506,880	CANADA	1930 1931	Strip map. Calgary to Edmonton. Lethbridge to Calgary. Winnipeg to Regina. Department of the Interior, Topographical Survey of Canada.

Scale	Country	Date	Remarks
1 : 500,000	United States	1930–1932	Department of Commerce sectional airway maps (9 sheets published, 92 planned). See *Aeronautics Bull. No. 10*, U. S. Department of Commerce.
1 : 500,000	United States	1923–1932	Department of Commerce strip maps. 32 sheets.
1 : 500,000	United States, Canada, and C. America	1923–1932	Air navigation charts, U. S. Hydrographic Office. 59 sheets published.
1 : 500,000	United States	1923–1932	Army Air Corps strip maps. 52 sheets published, 6 in progress.
1 : 500,000	Cairo to Baghdad	1922	Air Route strip map (rough sketches). Survey of Egypt. 3 sheets.
1 : 300,000	Germany	1928–1932	Reichsamt für Landesaufnahme, Berlin. Aeronautic edition of standard map.
1 : 253,440	United States	1932	Standard airway map, New York-Washington. Standard Oil Co. of New Jersey.
1 : 253,440	Canada	1932	Toronto-Ontario sheet. Geographical Section, General Staff, Department of National Defense. Aeronautic edition of standard map.
1 : 253,440	Canada	1931	Aerial strip map, Detroit-Toronto-Montreal-Quebec. 9 sheets. Geographical Section, General Staff.
1 : 253,440	England and Wales	1928–1930	Ordnance Survey, Civil Air Edition. 12 sheets.
1 : 250,000	Italy	1930	Carta Aeronautica d'Italia. 56 sheets, 6 sheets published. Based on standard map of Touring Club Italiano.
1 : 200,000	France	1911	Carte de l'Aéro-Club de France.
1 : 200,000	France	1911	Carte Aéronautique. Service Géographique de l'Armée.
1 : 200,000	France		Carte-Avions, Edition de la Guerre. Aéro-Club de France.
1 : 200,000	France	1923	Carte Normale Aéronautique Internationale. Aéro-Club de France.
1 : 200,000	Czechoslovakia	1928	Carte Normale Aéronautique Internationale. Prague Institut Géographique Militaire.
1 : 200,000	Siam		25 sheets in color, 30 sheets in black, 5 sheets in preparation.

Group 4: Local Maps

1 : 300,000	Germany	1928	Flughandbuch für das Deutsche Reich. Reichsverkehrsministerium. Airport vicinity maps.
1 : 200,000	Germany		Aeronautical edition of standard map. Topogr. Übersichtskarte des Deutschen Reiches. Each sheet ¼° of latitude, 1° of longitude.
1 : 125,000	United States	1931 June	The Columbia River Gorge. Department of Commerce Airway Map No. 137A.

Scale	Country	Date	Remarks
1 : 100,000	Czechoslovakia	1928–	Vicinity maps of airports. Insets on the 1 : 200,000 and 1 : 750,000 maps.
1 : 75,000	Europe	1927	Airport vicinity maps. Grosser Luftverkehrs-Atlas von Europa.
Various	United States	1927–1931	Loose-leaf airway bulletins, vicinity of airports (discontinued). Department of Commerce, Aeronautics Branch.
			Group 5: Large-Scale Plans of Airports
1 : 20,000	Germany	1928	Flughandbuch für das Deutsche Reich. Airport plans and oblique photographs. Reichsverkehrsmisterium.
Various	United States	1927–	Airport plans. Loose-leaf airway bulletins (discontinued). Department of Commerce.
1 : 63,360	Canada	1930	Airport vicinity maps on back of Topographical Survey air navigation maps.
1 : 14,400	Canada	1931	Plans of airports on back of Topographical Survey air navigation maps.

SHIP EVOLUTION AND SOCIAL EVOLUTION*

Sidney A. Reeve

A BROAD study of history as a record of social evolution reveals the ship as the one most dominant factor in its propulsion and guidance—at least, up to the time when the steam engine took hold in 1701. Yet even after the steam engine entered, the ship did not retire from activity as a molder of fate for communities. Steam merely took up the task of marine propulsion as its chief duty.

Evolution of Individual and Society Contrasted

The first step requisite for a perception of the truth of all this is to note the mutual independence and contrast which always has prevailed between individual evolution, on the one hand, and social evolution, on the other. Individual evolution ended before history began. What history records is the active evolution of the form of society, while the form of the individual remained unchanged.

Certain it is that, whenever we seek the highest type of human individual, whether in bodily, mental, or spiritual perfection, we by no means look to the latest product of the hour, but rather do we turn back through the centuries.

However opinion may differ as to just which model to select, it is plain at a glance that, whereas the history of social evolution presents a series of the most violent wholesale contrasts, as between war and peace, between poverty and prosperity, between stability and revolution, and between decimation by war or pestilence and expansive social life, yet the evolution of the individual, if indeed any at all has occurred, has proceeded, relatively thereto, with glacier-like slowness. Since individual evolution has been so slow that one can barely discern any evolution of mind or body at all since the ancient Greeks, or of the spirit since Confucius, Brahma, Jesus, or Mohammed, how can we assume to explain all this myriad of rapid and violent contrasts in social conformation that have occurred meanwhile, during the last dozen or twenty centuries, except by a frank recognition of what is really the one most basic fact underlying all history, namely: that social evolution has proceeded entirely independently of any parallel evolution of the individual, whether nationally or racially averaged.

*The argument, here stated in condensed form, is elaborated in the author's three-volume work, "The Evolution of Social Crises," now in manuscript.—Edit. Note.

This is true because a society consists not of an aggregation of individuals, the character of the aggregation being determined by the character of the components, but of a *form of organization* of individuals in which the character of the organization is quite independent of the character of the components organized—just as the form of a solar system, for instance, depends solely upon relative masses and orbits, without regard to whether the component planets be fertile inhabited globes, like the earth, or arid lifeless rocks, like the moon.

In other words, the elements of a society do not consist of persons but of *relationships between* persons. The social element consists of a single relationship, involving at least two persons. No one person is a social element. And the pages of history prove that, rather than this being an academic distinction, splitting a hair, these relationships between persons can and do alter rapidly and violently, reacting upon individuals in the utmost contrast of fate yet quite independently of any alteration whatever in the individuals themselves thus drastically interrelated. Without a thorough grasp of this basic distinction history cannot be understood—nor current events either.

It is in this vital matter of form of social relationships that the ship, foremost among all man's tyrannous appliances, has played so dominant a part. We can understand neither history ashore nor the evolution of man's activities afloat, without first grasping clearly the utter dependence of man's forms of social relationship upon his facilities, in any given era, for intercommunication and economic interaction. And in all history until the steam passenger railroad appeared, in 1829, this interaction has been effected almost wholly by water. History has not been made upon the solid land but upon the trackless sea—which is one reason why history is so hard to understand.

Dependence on Extra-human Sources of Power

Another basic fact underlying all social evolution is that society has developed always and only to that degree that it has been able to employ extra-human sources of energy to supplement its own muscular powers. This is obvious as regards today; but our historians have failed to teach as they should that this same fact has applied, with equal cogency, to all earlier eras. This is why the ship figures so prominently in history; for, after the horse, perhaps, the ship was man's first instrument for drawing upon extra-human sources of power to aid his instinct for intercommunication.

In this study of extra-human sources of power the slave must be included as the simplest instance. For the slave was not a mem-

ber of, nor a factor in, the life of the slave-owning community except through his contribution of sheer inanimate power. As a man he did not exist. When he gave out he was cast to waste just as carelessly as we now cast worn-out or obsolete machinery into the junk heap. In comparing modern with ancient history it may help to remember that, in the one item of automobiles alone, overlooking all factory, railway, steamship, and airplane power, each American man, woman, or child commands, on the average, the equivalent of about four hundred able-bodied slaves.

The Slave-propelled Ship

So it happens that we find all the more prominent early civilizations centered about slave-propelled ships. The wind was utilized when it favored, but the slaves were utilized always. The phase of this employment that led directly down to today bordered about the Mediterranean. Egypt, Persia, Greece, and Rome all rose upon and fell by the economic energy contributed by their slave-manned ships. The three first named fell only when that power was overshadowed by a greater marine power. Rome fell from no external attack, but from the expansion of this slave-propelled internal energy.

Judea alone forms an exception, and Judea's contribution to social evolution consisted in a unique detail, which survived her demise as a nation. The Jews, aside from Jesus, have formed mere raw material for assimilation by every western nation—imparting no social forms to any of them.

It happens, too, that at the dawn of history we find already at work in at least three remotely separated centers of social evolution—the southeastern coast of Asia, the Mediterranean Sea, and the narrow seas northwest of Europe, respectively—a well defined and developed type of ship, essentially alike in all these remote centers yet developing differently as the centuries passed. This type consisted of an open hull, steered at the stern, propelled by oars, and carrying a single mast and baggy square sail to catch fair winds. The evolution of this primal type of ship into modern forms, with its remarkable reaction upon the form of society ashore, this paper proposes to trace here in outline. The libraries are filled with tomes recording the details of hull and rigging of ships of the past, but not a single book known to the writer contains even a paragraph as to why these details developed nor what has been their compulsion on social changes ashore.

Egyptian and Grecian Ships

The ships that energized the line of social evolution that has finally developed into the civilization of today were primarily the

Egyptian and the Grecian. Persia rose to greatness as probably the best illustration of a horse-propelled civilization, though her rise was doubtless aided by gulf and river navigation of some sort. But this type of society may be dismissed from further consideration with the remark that Charlemagne's empire a dozen or more centuries later formed the only other horse-powered empire figuring appreciably in the evolution of our own times. Once embarked upon the sea the Persians found themselves in inevitable conflict with the essentially maritime Greeks. There, as when Charlemagne tried to drive the vikings off his northern coast, the Persians, unfamiliar with the sea, fought at a disadvantage. The Greeks won, just as the vikings won.

Even before this Egypt had grown into a power through its river traffic on the Nile. The Egyptians used large ships, but they were river ships, equipped with powerful sails but paddled instead of rowed. Later on the Egyptians adopted oars, copied probably from the Greeks, and oars were alone fit for the open sea; but in their indigenous type of ship, on which Egypt's greatness had been built, they reveal, in these paddles, their lavish waste of man power just as plainly to the nautical eye as they did in the building of their pyramids. And therein one can see half the reason why Egypt went down before Greece and Rome. The other half of the reason lay in Egypt's restricted hinterland; but this half lay in her lavish waste of what man power she did command, in the form of slaves—a commodity which Rome learned well to conserve.

Greece rose to greatness through the power and efficiency of her slave-propelled biremes. Her habitat was a rocky, sterile peninsula; but her foreground was an archipelago unrivaled as a scene for maritime trade. On this economic fatness Greece rose steadily in power, until finally she clashed with Rome.

But the area on which any community can feed and grow, by marine trade, depends directly on the efficient radius of action of her ships. A bireme in its day was by far the most efficient ship that had yet been produced. It could proceed in any direction, just as a steamship can, regardless of the wind, provided only the weather were not too heavy for its power. But its power and fuel were of a bulky sort. Two watches of oarsmen had to be carried, besides officers and soldiers and sailors, with food for all; and this meant a short radius without replenishing. If cargo had to be carried profitably, it meant a still shorter radius. The history of the Phoenicians is eloquent as to all this. Grecian hegemony could not spread beyond the radius of her biremes. Nor had she a hinterland much better than that of Egypt. Consequently she never became oversized and overrich, as did Rome, but expended her margin of strength rather in the line of esthetic development.

The Secret of Rome's Greatness

The orthodox will be aghast when it is said here that the sole secret of Rome's greatness lay in her more central location within the Mediterranean, whereby her radius of effective ship action swung over a wider extent and variety of tribute-bearing lands. Her start she owed to a more productive habitat than that of Greece, but soon thereafter it became the limitations of her ships that demarked the boundaries of her empire. They carried her to Africa, where the desert soon stopped her. On the northeast the forest barbarians checked her. But her ships carried her past the Alps into Gaul, whence she proceeded overland into Britain; they carried her eastward into Judea; but they never carried her past the Pillars of Hercules nor even effectively into Spain. Greece she conquered almost apologetically, whereupon, using Greece as a base, she could work effectively into the Black Sea.

History cannot be understood except as a series of successful business enterprises, each of which grew into a vast power and tinctured the ethical, religious, and literary peculiarities of its era according to the peculiarities of its economic success. So long as any given enterprise continued profitable, its era grew in power as it grew in prosperity. So soon as profits fell off, its political power declined. If those profits declined gradually, as in the case of Rome or the medieval baronage, the power declined gradually and without cataclysm. On the other hand, if the profits grew without limit, until the enterprise died of apoplexy, its end brought a terrible social cataclysm. This was the case with the medieval Church, and with the several absolute Crowns. It is the case also with commercialism today, collapsing now before our very eyes.

The Roman system of creating virtually nothing at home (all its crafts being in the hands of slaves), but deriving its main income by conquest, spoliation, and tribute, was an excellent instance of this universal law. As the radius of Rome's conquests extended, the overhead costs of doing business increased in geometric ratio. Communications could be kept open, and frontiers maintained, only at greater and greater cost. Hence net profits decreased.

By the first century of our era we see plain signs of distress from this source. Among these signs one may be instanced as illustrative. At the very time when the Roman emperors were becoming—and from the same cause—the very worst known to history, in the way of brutish lack of self-restraint and consideration for others, we find Rome establishing her first laws for the protection of slaves from wanton murder by their masters. The explanation of this apparent paradox is simple. The supply of slaves was decreasing; their conservation became a public necessity.

Three centuries later Rome had reached the point where her net income had virtually disappeared. No longer supplied from without, she must perforce produce at home. But her producers at home were all slaves, and the slaves were virtually all Christians, because the Christian religion alone offered hope to a slave. Hence persecution of the Christians had to cease. Soon thereafter the Christians, being the sole source of economic strength, rose into political power. From that time forward Rome became the center of western Christianity.

Simultaneously, of course, and for the same reason, their costs eating up all their gross income, the bireme and trireme disappeared from the Mediterranean. Navigation continued to be conducted by oared ships manned by slaves, but the ships were smaller and utilized their power more economically.

The Scene Shifts to the Northwest

The scene now shifts to the northwest of Europe, where the English Channel and North Sea were being navigated by a type of vessel mechanically like the Egyptian, Greek, and Roman ships—yet with differences enough to preclude possibility of either having been derived from the other—but smaller and manned by free men. The seeds of the present economic system that has now spread around the globe we do not find in the Mediterranean civilizations but, instead, in the primitive community living in the delta of the Rhine and Meuse. There the entry of the Romans, overland, first disclosed to history a tribe called locally the Frisians and by the Romans Menapii, which already operated and had long operated a system of simple but specialized crafts. Here a system of water-borne trade along the sluggish rivers and occasionally across the narrow sea was carried on by free men—a system that grew irresistibly down through Clovis and Charlemagne's succession to the Romans, alone survived the anarchy that followed the latter's death, and finally emerged, about a thousand years after Christ, as a definite burgherdom of irresistible, if subconscious, expansive power.

In all this, and in all that followed, not one constructive step was inherited from Rome—which had bequeathed to it nothing but traditions of corruption and slavery. Indeed, in the entire circle of Mediterranean civilizations there is nowhere instanced any precursor or embryo of this novel combination, which had arisen spontaneously in the Northwest and which ultimately by its own inherent energy and truth to natural law grew into what the Mediterranean had never seen, namely a free economic interaction between specialized and contrasted crafts. What little it later borrowed from the Mediterranean ultimately proved to be a handicap and had to be discarded.

The Conflict between Mediterranean and Northwest

Not till five centuries later did these two systems, that of the Mediterranean and that of the Northwest respectively, come to decisive conflict, in the war between England and Spain for control of the Atlantic. During fifteen centuries the two systems had been in unconscious rivalry. That of the Mediterranean died gradually, or remained moribund, until Spain was galvanized into temporary vigor by the injection of gold from America, at a time when the chief need of the Northwest was a larger volume of reliable currency. Meanwhile the system of the Northwest was growing steadily, if quietly; until finally, in the defeat of the Armada, in 1588, the fate of the Mediterranean system was settled.

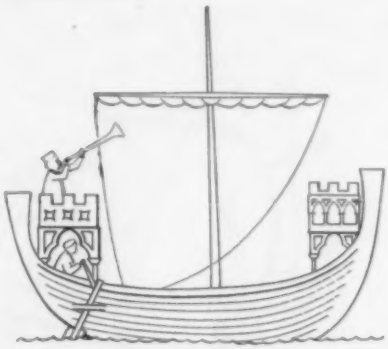

Fig. 1—Norman castellated ship, from the great seal of Winchelsea (after Chatterton).

This event, one of the principal milestones in history, is nowhere so described by historians. The truth is that in this event, the economic foundations on which had been built the tombs and pyramids of Egypt, treasure chambers all of them, the beautiful temples of Greece, also treasure houses, and the temples, forums, laws, and institutions of Rome, all concerned in the division of vast tribute—in the defeat and dispersion of the Spanish Armada, in 1588, the last remnant of that ancient civilization and power went down forever, beaten by the greater efficiency of the free, water-borne system of the Northwest.

For all this long history of conflict was written, as it was made, not in comparisons of military power on land, but in comparisons of efficiency of water-carriage afloat. Let us see, briefly, how it came about.

Up to 1066 the ship of the Northwest had been what has been called the viking type—the one ancient ship of which we know the most, because several specimens of its hull have survived. With the Norman conquest of England this ship became modified into what should be called the Norman type—the type that played an active part in England's rise throughout the ensuing century.

The vikings seldom fought at sea. They were seacoast pirates. But the Normans, splendid fighters ashore, had no sooner taken charge of insular Britain than they found need for fighting at sea. Always accustomed, when fighting ashore, to battlemented castles, they could not fight satisfactorily at sea until they had built into each

viking type of ship two little wooden battlemented castles, about eight feet high, one near each end. The name of one of these castles, "forecastle," still survives; but the name "sterncastle" has been gone as long as the reality.

The Evolution of the Cog

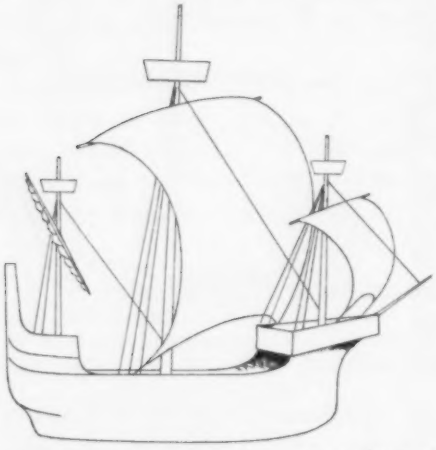

Fig. 2—Plantagenet cog of 1304 at the battle of Gouwe (after Konijnenburg).

About the time of the Angevin invasion of England, in 1153, an event almost as epoch-making as the Norman invasion, for all that it was done without war, the Norman ship developed into the cog. Properly the cog should be known as the Plantagenet type of ship; for the bulk of that tremendous history that was made under the Plantagenet kings, when the Cinque Ports wielded more power than even the strongest of the Plantagenets, was done in cogs. Yet the cog differed from the Norman ship only in that each of the two castles, originally built independent of the hull, had been enlarged into an integral part of the hull, strongly made and projecting well out over the water both ahead and astern. Finally the battlements were omitted, being replaced by plain bulwarks.

This form of ship persisted virtually unchanged through some three centuries, because it proved to be an ideal form for the combined job of propulsion and combat. For in those days every ship had to fight her way. No distinctions were drawn, then or long afterwards, between merchantmen and men-of-war. The cog still relied upon oars, plied from either side of the waist of the ship, with the same mast and squares'l, later developed into two; but the waist was largely protected by the surmounting fore and stern castles with their decks six feet above the main footboards and their bulwarks rising higher still. Thus the crew worked in comparative safety, while the officers had the vantage in viewpoint. All men were free and equal in many respects. Whereas on the Mediterranean no soldier could ever think of touching an oar, the symbol of slavery, in the Northwest a man would jump from oar to rope or crossbow unhesitatingly. This freedom was a tremendous advantage when contest between the two systems finally arrived.

The prime limitation of the cog lay in the impracticability of

enlarging the type beyond a preferred capacity for some thirty men. A few larger ones were built. The *White Ship*, in which the only son of Henry I of England was drowned in 1120 was said to have carried three hundred persons, and the accident might easily have been due to overloading. Hence the maritime powers of those times ran to fleets of enormous numbers. In the great naval battle off Sluys, in 1340, three hundred French ships are said to have been sunk; and the man who went overboard, in the armor of those days, did not return.

The ship remained virtually unchanged in form and alike in all European waters, except as to crew, until the introduction of the carack, a step forward in naval architecture whose importance cannot be exaggerated; for the carack automatically initiated oceanic exploration and so revolutionized social forms ashore.

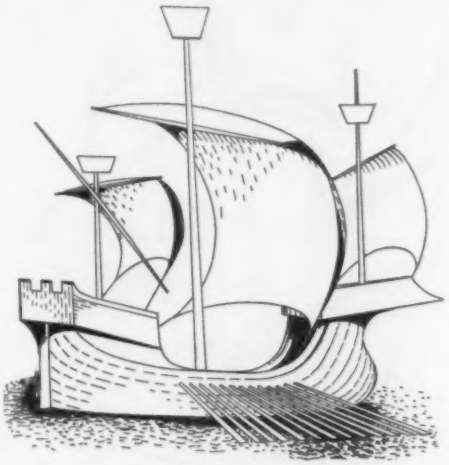

FIG. 3—Plantagenet cog of 1351 at the battle of the Meuse (after Konijnenburg). This is interesting because it shows apparently a lateen sail upon the mizzen-mast: but retention of oars and lack of a watertight deck prevented realization of the seagoing abilities of this rig.

APPEARANCE OF THE CARACK

In studying the evolution of the ship the reader must remember that mariners are inevitably conservative in spirit, since a false experiment means death; and this made progress trebly difficult. Hence the mere fact that, nautically speaking, the carack had nothing in common with the cog itself constitutes a milestone in history. The carack differed from the cog in three basic respects; and these are the more significant since none of the three might be adopted independently of the rest. Yet the adoption of all three at once made of the cog an entirely different type of ship, necessarily handled differently and consequently accomplishing widely different results.

In the first place the carack had a complete water-tight deck, whereas the cog was virtually open; in the second place the presence of the deck forbade the use of oars, except for a few sweeps for wafting the ship into or out of harbor in calm weather; and in the third place the carack, being now obliged to abandon oars as her reliance for holding her head to the wind in a gale and to rely solely upon canvas instead, was the first ship in the history of navigation to be rigged

with a combination of square and fore-and-aft canvas. Each form of sail had been used before, but never in combination.

Nominally the carack had three masts, although only two of them were sail-carriers. Besides the usual mainmast and big squares'l stepped in the waist, the carack stepped a smaller mizzenmast on the sterncastle, spreading a lateen sail. On her forecastle she stepped a still smaller mast, but it spread no canvas. Canted well forward, it served chiefly as a fair-leader for main bowlines, etc. It was also used to cathead the anchor. Later its forward slant increased, and ultimately it became a bowsprit. But not until the Elizabethan era did this bowsprit carry canvas. The mainmast sometimes spread a square tops'l.

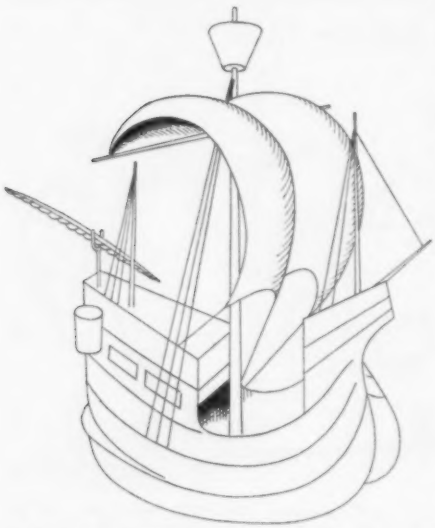

FIG. 4—Flemish carack of 1470 (after Van der Kellen). Note the far better protection from the weather for both cargo and crew, the extremely baggy form of the mains'l, and the third sheet where in the modern ship a buntline is rigged.

The names indicate the Mediterranean origin of the craft. The aftermost mast, being medium in height among the three, became the "mizzen," a corruption of Italian mezzanine. Lateen is a phonetic spelling of *latine*, in *voile latine*, "Latin," or Mediterranean, sail. The ship probably originated in a purely economic demand, coming from the merchants ashore, for better carriage of their goods than open ships could supply. But the covering of those goods from the weather then enforced these other changes, and all together revolutionized both navigation afloat and all social forms ashore.

THE OCEAN OPENED TO MARINERS

The error of supposing that it was the lack of a compass that restricted sailors to coastwise ventures and kept them off the open ocean is proved both by the extent to which they went to sea before they had a compass and also by their failure to take advantage of the compass after having inherited it from the Saracens but before the carack appeared. The difficulty in navigating open water lay not primarily in doubt as to direction, except in foggy weather; and then it applied even more strongly to waters near the coast, where rocks might destroy, than in the open ocean. The difficulty lay, instead,

in the limitation of an oared ship in power to hold her position to the wind in a prolonged storm, when oars could barely be used at all and then only by great exertion. In a gale on open water, when rowers became exhausted, a cog must fall off and founder. To be safe, she must never be farther from port than her oarsmen might reach.

But the carack, in contrast, could lie to indefinitely under sail, with the deck keeping the water out, the helm lashed, and all hands snug below. This fact alone, as the qualities of the carack came to be recognized, opened the ocean to mariners who were no more courageous than their predecessors but who now for the first time had under their feet a ship that was fit to live on the ocean.

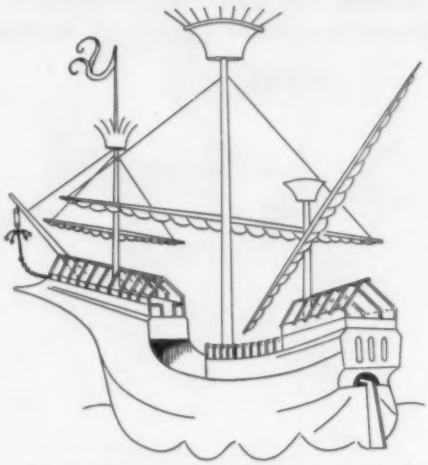

FIG. 5—Flemish carack of about 1490 (after La Roncière). This shows how elaborate the protection for the crew had become, a factor vital to success in oceanic exploration.

The carack could not sail appreciably to windward; and this lack, in contrast with the oared ship's ability to walk right into the eye of the wind, so long as she could move at all, explains the slow adoption of the carack. After 1270 there is no further mention of the carack in that century as doing anything noteworthy. The next century brings only two or three Atlantic voyages, of doubtful extent and profitability. But by the time of Henry the Navigator, in 1408, the carack had become an accepted standard and had developed in size and detail. In consequence the entire century was devoted to the vigorous exploration of the Atlantic. Yet Columbus, who came at its end and did nothing like the splendid work done by Vasco da Gama in extending the radius of exploration, sailed ships that at best were practically caracks, albeit the *Santa Maria* had both fore and main masts, each setting tops'ls, besides the lateen mizzen.

European Civilization Revolutionized

What these voyages did to European civilization ashore can barely be outlined here, so revolutionary was it. Wholly through the introduction of novel commodities and plenty of gold and silver, the Northwest of Europe, long starved for adequate circulating medium, was electrified into a new era. The Middle Ages had long based their economics on the guild for production and the hanse

for export, for there was very little internal trade, the guild workman selling almost exclusively to his immediate neighbor, unless he sold through a hanse for export. The Middle Ages now suddenly found themselves forced, through sheer volume of demand, to displace both guild and hanse in favor of the commercial corporation, symbolizing the transition to Modern Times. Ownership in industry, virtually unknown in an era in which each workman made his output entire from raw materials to final sale, now entered for the first time—to grow since then into our modern problem of the hour, world commercialism, itself the further product of the evolution of the ship.

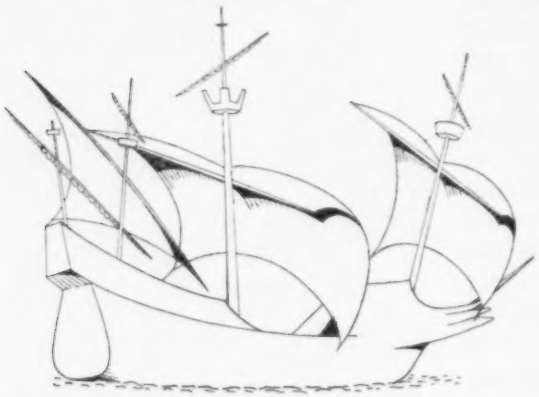

FIG. 6—French ship of 1548 (after La Roncière). This shows the transition from the pure cog to the Tudor or Elizabethan type. As soon as attempt was made to increase the size of the carack the difficulties which finally forced the elaborated Tudor type began to appear.

These basic economic changes changed also all the ethical standards and religious creeds. The Puritanism of the Middle Ages faded away, giving place to that reckless joy in life which only Rabelais has been competent to depict. The former antagonism of the all-powerful Church to "usury," money paid for the use of money, subsided first into quiet connivance at the spreading sin and then into frank repeal of its canons. The baronage, its profitability gone, finally dissolved and left the Crown, supported by prosperous burgherdom, supreme in power, except for the Church's rivalry.

Then came the supreme cataclysm, the contest to the death between Church and Crown—between Lion and Unicorn fighting for the crown, as the nursery rhyme has it. The Church naturally made effort to secure its usual share of the land's enlarged income, as well under this novel prosperity as before. But this resulted only in an exposure of its mercenary machinations before a Europe then given, above all things, to ridicule; and the Church gradually collapsed. The Reformation, almost wholly an economic revolution, rather than one of creed, ensued. The Church, the one great federal backbone of Northwestern society—from that Christmas Day in 800 A.D. when Charlemagne sealed his bargain with it, until the Reformation came—dissolved, the whole disintegrating into many local churches, some Catholic and some Protestant but all home-ruled instead of being ruled from Rome.

All this was the purely automatic fruition ashore of the appearance of the carack on the high seas. Not a particle of it was designed by man.

The Elizabethan Ship

The carack developed gradually into the Elizabethan type of ship, with which the ascendancy of England upon the Atlantic was settled and the deathblow was given to Spain as the last of the old Mediterranean slave-supported powers. The Elizabethan ship was much larger than the carack; for as soon as sails replaced oars it became practicable to build and maneuver ships of larger and larger size, as could not be done with the cog. This ability operated effectively to propel society along its forward path. It opened way for society to draw upon superhuman sources of power upon an increasing scale. Society has always had its progress thrust upon it, accepting it reluctantly, by the invention of better appliances by various individuals, each inventor quite unsuspecting what he did; but in no field, not even that of steam power, has this process been so clearly marked as in the evolution of the ship.

Fig. 7—Dutch ship of 1564 (after Van der Kellen). A realistic picture to the nautical eye, showing the ship closehauled on the starboard tack with so much of its baggy canvas drawing astern. Our best illustration of the Elizabethan type, with its series of poops aft and its bowsprit utilized as a cathead only.

In the Elizabethan ship to'gallants'ls appeared for the first time. A few ships having four or five masts were built, but three was the standard. The mizzen remained lateen. The bowsprit now carried one or two squares'ls, namely a waters'l spread on a yard beneath the sprit, and a sprits'l spread on two yards, at head and foot, supported by a spritmast which was stepped precariously above the bowsprit. And herein appears that peculiarity in rig that enforced the picturesque but unseaworthy hull characteristic of the Elizabethan type, with its series of poops towering at the stern and its head so low as to drive into green water in every moderate gale.

For these ships sadly needed fore-and-aft headsail. Their "bearings" (the center of lateral resistance of the water), as in all ships, were well forward; yet they had no lateral sail pressure to correspond, to hold the ship's head off the wind. Jibs on a ship's bowsprit were

yet unknown, although the Dutch for centuries past had used jibs on their small harborcraft.

Hence, to get this lateral pressure, the waters'l was tried first. But it could not be hauled close to the wind, because of the lack of anything solid out in space ahead, to which to lead its tack. Hence it could be used only in running. Then the sprits'l was added above. This could be hauled close on the wind, because of its two yards; but it was too small to be effective, nor could it be enlarged, because of the weakness of its manner of support. So the poops were piled up high on the stern, to bring the center of gravity of the hull aft and the forefoot up out of the water, while the great foremast was stepped just as far forward as possible—often actually out over open water, and canted forward at that, in the effort to get headsail to bear—while the ship wallowed through every seaway as best she might.

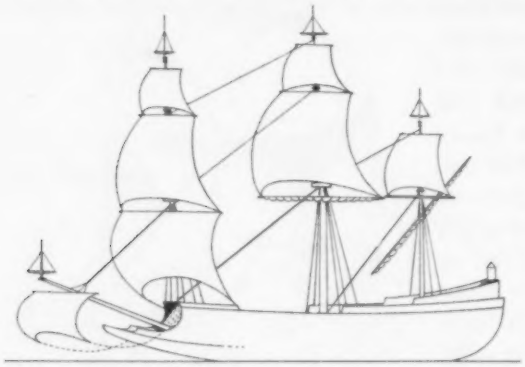

FIG. 8—The *Sovereign of the Seas*, 1637 (after Chatterton). A Stuart type of ship, an important link between the Tudor and Georgian types, showing the benefit of even the inadequate relief offered by a longer bowsprit, with the heavy foremast, topmast, and to'gallantmast stepped well out over the water.

IMPROVEMENT OF LAND COMMUNICATIONS

This nautical stupidity virtually halted progress in naval architecture for a time. Meanwhile appliances for communication ashore were being brought up in arrears, by the introduction of the stagecoach and the canal. In Holland, somewhat later, the *trek-bots* on the canals actually carried beds and restaurants, making travel an unprecedented marvel of comfort. For in that era the roads and carriages were so crude that even the women preferred horseback to wheels. Queen Mary, the first to recognize wheeled vehicles, had to have six horses to draw her coronation coach—not for show, but to drag the thing laboriously through the mudholes of a few miles of London streets. Queen Elizabeth had a road specially built in her honor; and its excellence is attested by the fact that her Majesty was forced to alight from her carriage only thrice, during her first transit, while the servants pried the wheels out of the mud with rails. The younger sister of Lady Jane Grey died from the effect of a forced trip of some fifty miles in two days, in a springless coach, over the roads of that period. It was not until 1665, a century later, that

Pepys records his first trial of the newfangled coaches with springs—concerning which he was not enthusiastic.

One little symbol of all this tribulation survives to this day, in every chauffeur's uniform. The woman of those days normally traveled on horseback, sitting on a pillion behind a male companion in the saddle, to whom she held on by means of an arm around his waist. With rural bumpkins this was well enough; but when Queen Elizabeth found herself obliged to embrace thus an ordinary equerry, or else fall off, she objected. She had the equerries all wear coats having a short stout belt set into the back, at the waistline. Through this belt the woman could thrust her arm. Look at the back of any uniformed chauffeur of today and you will see this same belt, a standard feature in his uniform.

FIG. 9—English ship of the seventeenth century (after Chatterton). It tells the story of the difficulties against which early transatlantic navigators had to contend. It was not the small size—yachtsmen are now crossing in smaller ships; the trouble lay in the rig.

GEORGIAN AND VICTORIAN SHIPS

To return to the topic of the ship, the next type to evolve from the Elizabethan has been called the Georgian type. The change from one to the other involved merely the addition of jibs spread upon the bowsprit and the addition of square tops'l and to'gallants'l on the mizzen topmast above the lateen; but these changes in rig altered the entire shape and serviceability of the hull. Down came the tall ungainly poops. Up came the bows, now higher than the waist and again fit for lifting the ship's head out of a sea. Again the ship became seaworthy, and again she might be built bigger, much bigger, yet still remain manageable. But the lateen mizzen persisted until after the American Revolution, which event marked, in general, the change from the Georgian to the Victorian type of ship, the latter having the modern trapezoidal spanker on the mizzen.

But eras in ship evolution overlap confusingly, older types holding on in some places long after they had become obsolete elsewhere, or for other services. For instance, the *Royal George*, which drowned so many fine naval officers and men by turning turtle in her dock in 1790 was still of Georgian rig; but the ships with which Yankee skippers were even then setting the youthful United States upon its feet were all of Victorian rig.

The later details—double tops'ls, double to'gallants, steel hulls

and masts and rigging, and steam hoisting power—are all familiar to the older men of today. The final note of interest is this: that to the very end the problem of manageability, as size was increased, remained the critical factor controlling ship evolution and so, through ship evolution, the evolution of economic power, and hence political power, ashore. The big steel four, five, and six-masted ships and barks of the opening of the present century gave way before steamship competition because they could not be handled. Every one of them, including the one seven-masted schooner, *Thomas W. Lawson*, was driven ashore through unmanageability.

Modern Facilities for Navigation

Eventually, of course, the sailing ship must inevitably have capitulated to steam, for the steamship is evolving steadily in size and efficiency. But history did not go that way. The sailing ship disappeared because her designers did not have time enough—so rapidly did the steamship evolve—to learn how to build big sailing ships that were still manageable. So that within a few years sails have virtually disappeared from the seven seas.

But the preëminence of the ship in dominating events ashore still continues, even if steam is now lord and master. Indeed, the dominance of the ship has only been heightened thereby. Our problems today are no longer mere national ones solely because the higher power and efficiency of the steamship, backed by the cable and the radio, has now made of the entire world a single community. Whether we like it or not, our problems have become world problems, active simultaneously throughout a unitary community encircling the globe.

Yet more than ever social evolution stands revealed as a matter of invisible relationships rather than of tangible personalities or even nations. The problems of social evolution are being both created and solved, as of yore, by relationships established automatically and imperceptibly across vast wastes of water, rather than determined academically in the forums ashore. The gradual disappearance of our most cherished tradition of the past, the Monroe Doctrine of isolation—the gradual annulment of our instinctive reluctance to considering ourselves responsible for any task more remote than the economic development of the American continent—all this is being ordained inexorably, before our very eyes, as ruthlessly and irresistibly by the entrance of modern facilities for navigation and communication, as the guilds, hanses and sacred church canons of the Middle Ages were doomed by the introduction of the innocent-looking carack.

In the brief outline given above, the story of ship evolution and social evolution that yet remains to be written is barely suggested.

SUBMARINE VALLEYS*

Francis P. Shepard
University of Illinois

CHARTING of Georges Bank has just been completed by the United States Coast and Geodetic Survey, and a valuable service rendered the shipping—local, coastwise, and trans-oceanic craft—that frequents this busy corner of the Atlantic. For shoal water here extends nearly 200 miles east of Cape Cod and is notorious for its strong and erratic currents and prevalent fogs.

Canyons of Georges Bank

In the course of the three years' work on the bank many interesting scientific data were brought to light, the most spectacular being the submarine canyons that notch the continental slopes outside the bank. Three years ago a canyon called Corsair Gorge was discovered, and in 1931 several others were found; but in no case were soundings made in sufficient abundance to determine more than their approximate form. This past summer it was decided to examine some of the valleys in more detail to determine their value as landmarks for navigators. The writer had an opportunity to accompany the survey party during this investigation, the result of which was to reveal an area of such relief and irregularity that it dwarfs by comparison anything above water in eastern North America and must rival the grandest topographic features of the West. Only the upper half of the two-mile high continental slope was charted, but a contour map of the area shows a series of steep-walled canyons cut thousands of feet deep into this escarpment. Most of these are deeper than the Yellowstone Canyon, and the greatest must be comparable with the Grand Canyon of the Colorado. These canyons have every indication of a fluvial origin, and since the valley floors are traceable to depths of at least 7000 feet it is evident that during the valley-cutting stage New England must have been a plateau at least a mile and a half above sea level.

The steepness of the canyon walls, probably exceeding 45° in places, makes it appear probable that the ancient rivers in forming these canyons cut through solid rock rather than through the soft

*Revision of a paper presented before the National Academy of Sciences, Nov. 16, 1931.

The writer wishes to express his appreciation for the help received from various members of the United States Coast and Geodetic Survey towards the gathering of much of the information presented here.

sediments of the ocean floor. The writer obtained fragments of a limestone containing quartz sand grains and small pebbles from several portions of the wall of one of the canyons, which partially confirms the deductions concerning their rocky nature. Only a small number of samples were obtained elsewhere, and in each case the material was a sandy mud.

The outer portions of the valleys have hummocky topography suggestive of landslide débris and are indicative of what may represent the most recent development in the history of submarine valleys.

Distribution of Submarine Valleys

Since elongate depressions on land surfaces are referred to as valleys regardless of their mode of origin, it seems justifiable to use the term "submarine valley" in referring to the various types of elongate depressions that cut the continental shelves and slopes. It may prove advisable, however, to apply more specific names to the different kinds of submarine valleys as their origin becomes more certain.

Submarine valleys have been the subject of scientific discussion for half a century. Several decades ago Spencer[1] and Hull[2] published papers with maps of the Atlantic-facing continents showing the extension of present-day rivers across elevated continental shelves terminating at points now many thousands of feet below sea level. These extensions were based on soundings on coastal charts, but the accuracy of the methods of chart construction was apparently not evaluated. As a result valleys were drawn even in places where one or two doubtful soundings were the only excuse for such features. Recent surveys have shown that some of the hypothetical valleys do not exist, but others have been authenticated and many new ones discovered. During the last eight years the United States Coast Survey has mapped large parts of the continental slopes by echo soundings, which permit great detail, and by bomb distance control, which gives accurate locations out of sight of land. While previously some of the inshore and shallower parts of the valleys were well charted, the recent work has at last made it possible to delineate the actual form of many of the deeper offshore valleys. The time has come to reëxamine the whole subject.

Well authenticated cases where the base of these depressions is more than 1000 feet below sea level include the series of valleys just discovered off New England and the well known valley off the Hudson; almost a score along the coast of California, and nearly as many off the state of Washington and Vancouver Island. South America

[1] J. W. Spencer: Submarine Valleys off the American Coast and in the North Atlantic, *Bull. Geol. Soc. of America*, Vol. 14, 1903, pp. 207–226.

[2] Edward Hull: The Sub-Oceanic Physiography of the North Atlantic Ocean, London, 1912.

has one such valley near Cape San Roque and another near the Esmeraldas River of Ecuador. Several submarine valleys are known off the east coast of Korea, off both sides of Japan, and along the east and south coasts of Formosa; there is a valley adjacent to the mouth of the Ganges and another to the Indus and several off Ceylon. There are several submarine valleys off the east African coast south of Zanzibar and on the west side off the Congo, Ogowe, and Niger rivers, one off the Gold Coast, and another off Cape Verde. One issues from the Bay of Gibraltar; there are several off the Portuguese coast and one off southwestern France. Valleys of less certain character but of considerable depth and probably similar to those listed above occur in abundance off various parts of the Mediterranean, in many places off a long stretch of the Brazilian coast south of Cape San Roque, off most of the west coast of Mexico, and off various parts of Africa.

There are only a few stretches of the continental shelves where soundings are abundant enough to make it fairly certain that these deep valleys do not indent the outer margins. The valleyless areas include the east coast of the United States south of Cape Hatteras, the west coast from Cape Mendocino nearly to the Columbia River; the east coast of Asia off the Yellow Sea and the Gulf of Siam, and perhaps the south coast of Asia in the Gulf of Martaban and off western India south of the Indus.

Off glaciated regions there are trough-shaped valleys on the continental shelves that are quite different from the submarine valleys off unglaciated regions. I have discussed these troughs elsewhere,[3] so that the present paper will be confined to a consideration of the valleys off unglaciated regions. Most of the latter have characteristics typical of youthful river-cut valleys on the land. They are generally V-shaped in cross section and sinuous in their courses, and many of them have tributaries of a dentritic pattern. They slope outward in a general way but have some basin depressions and hummocky elevations along their courses. At least fifty of these valleys in various parts of the world attain depths of more than 5000 feet: many have bases thousands of feet below the ocean floor in which they are sunk. Add to their other characteristics steep slopes, and it is evident that these canyons in some cases are truly comparable with the great canyons of the lands.

Origin of the Valleys

Several hypotheses have been suggested to explain these valleys. Besides the idea of river cutting and great displacements of the continental borders, they have been attributed to rifting or faulting

[3] F. P. Shepard: Glacial Troughs of the Continental Shelves, *Journ. of Geol.*, Vol. 39, 1931, pp. 345–360.

action, to submarine currents, and to the collapse of submarine solution channels. A new suggestion that I wish to propose is that the valleys were originally cut by rivers but submerged a long time ago and filled in with sediment during the cutting and building of the present continental shelves, being subsequently reopened from time to time by great landslides.

The Diastrophic Explanation

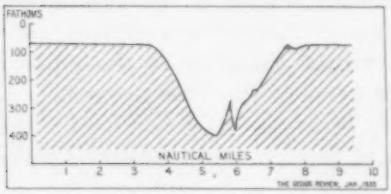

FIG. 1—Section showing the uniform level of the continental shelf on each side of a submarine valley. The vertical scale is exaggerated eight times.

Lawson, referring to valleys off California,[4] de La Roche-Poncié, referring to a valley off southwestern France,[5] J. W. Gregory, referring to valleys off Cyprus and Morocco and to the Hudson submarine gorge as well as the St. Lawrence trough,[6] and Yamasaki, in discussing valleys off Japan,[7] have all suggested faulting as an explanation. Wegener considered the valleys as due to rifting action.[8] It is possible that some of the valleys are explicable in diastrophic terms, but probably a much greater number are not of this origin. Most of the valleys run in directions transverse to the shore line, whereas structural features are dominantly parallel in trend to coasts; the sinuous courses of most of the valleys and the dendritic tributaries (Fig. 2) are not typical of fault valleys; and finally the typical relation between the valleys and the continental shelf (Fig. 1) does not suggest faulting. On the sides of grabens it is usual to find horsts or step faults, rather than the accordant plateau levels that are found on the sides of most of the submarine valleys.

Submarine Currents

Buchanan considered that the flow of fresh water out over the ocean beyond a river mouth would cause deep countercurrents that

[4] Andrew C. Lawson: The Geology of Carmelo Bay, *Univ. of Cal. Publs. in Geol.*, Vol. 1. 1893–1896, pp. 1–59.

[5] M. de La Roche-Poncié: French Hydrographic Office, 2ième Cahier, Rapport sur la fosse de Cap Breton, p. 70.

[6] J. W. Gregory: A Submarine Trough off the Coast of Cyprus, *Geogr. Journ.*, Vol. 78, 1931, pp. 357–361. *Idem:* The Earthquake off the Newfoundland Banks, *ibid.*, Vol. 77, 1931, pp. 123–139. This article discusses the St. Lawrence-Cabot Strait trough concluding that it is a graben. The writer has presented evidence that the same trough is of glacial origin (*Bull. Geol. Soc. of America*, Vol. 42, 1931, pp. 853–864). J. W. Gregory: A Submarine Trough near the Strait of Gibraltar, *Geogr. Journ.*, Vol. 79, 1932, pp. 219–220. This article describes the trough as being of the type the writer has considered as confined to glaciated coasts. However, neither the soundings nor Gregory's description appear to correspond with what the writer has termed "glacial troughs of the continental shelves."

[7] Naomasa Yamasaki: Physiographical Studies of the Great Earthquake of the Kwanto District, 1923, *Journ. Fac. of Sci., Imp. Univ. of Tokyo*, Sect. 2, Vol. 2, Part 2, 1926, pp. 77–119.

[8] Alfred Wegener: The Origin of Continents and Oceans (translated by J. G. A. Skerl), London, 1922, p. 178.

might excavate or at least keep open the submarine canyons off the large rivers.[9] More recently Lawson has considered the idea that submarine currents have maintained a passageway between delta deposits that were forming on the sides.[10] Submarine currents have

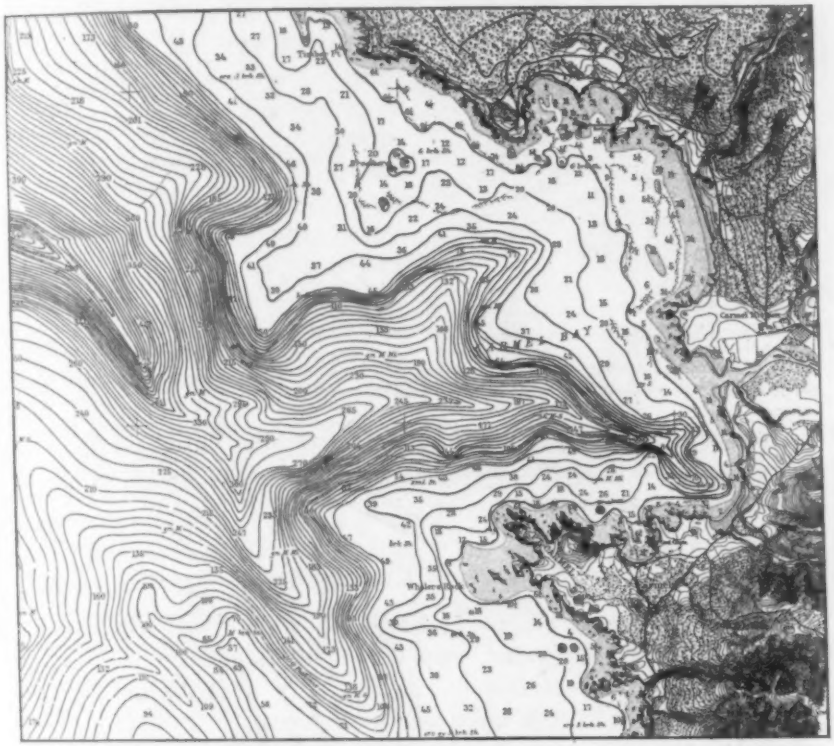

FIG. 2—The dendritic valley pattern off the Carmel River, Cal. Contouring by the late Professor H. H. Robinson from some charts kindly furnished to the writer by Mrs. Robinson. Contour interval 10 fathoms.

not been investigated sufficiently in this respect, but several things suggest that they are not an important factor in the formation of valleys.

The bottoms of at least two well known submarine valleys, the Congo Trench[11] and the Fosse de Cap Breton,[12] have been reported as having quiet conditions. Lack of vigorous currents is also suggested by the usual occurrence of silt and clay deposits in the valley bottoms while sand is found on the adjacent shelves. Rock is reported on the walls of some of the valleys, and for the erosion of rock gorges currents

[9] J. Y. Buchanan: On the Land Slopes Separating Continents and Ocean Basins, Especially Those on the West Coast of Africa, *Scottish Geogr. Mag.*, Vol. 3, 1887, pp. 217–238; reference on p. 223.

[10] A. C. Lawson: The Continental Shelf off the Coast of California, *Bull. Natl. Research Council No. 44* (Vol. 8, Part 2), pp. 3–23; reference on p. 15.

[11] Captain Cust: North African Pilot, Part II, 6th ed., 1910, p. 181.

[12] La Roche-Poncié, *op. cit.*, p. 66.

of extraordinary power would be demanded. Since most of the valleys are in seismic areas the steepness of their sides suggests that if they were not cut in rock they would cave in when subject to earthquakes. One exception was shown by a recent survey of Monterey Bay. On the floor of the canyon sand and gravel were found overlying clay and silt.[13] However, the recent findings of the Hydro-biological Survey indicate that the water in the submarine valley is arranged in static layers.

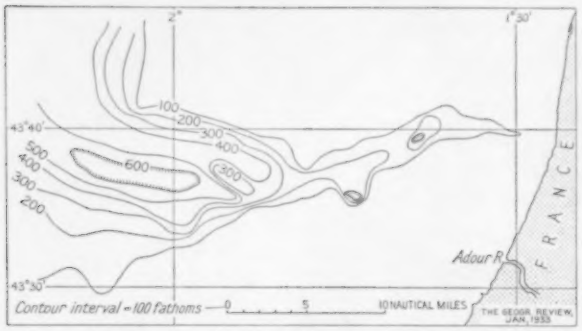

FIG. 3—The inner portion of the Fosse de Cap Breton illustrating the straight coast which occurs inside of many submarine valleys.

As a means of keeping old valleys open, currents may be important, but the regrettable dearth of information concerning current conditions along the valley bottoms makes it unwise to give much weight to this suggestion at present.

SOLUTION CHANNELS

Benest in 1889,[14] W. S. T. Smith in 1902,[15] and Commander Gorceix in 1922[16] suggested, apparently independently, that some submarine valleys were due to the action of underground streams producing caves and sink holes under the ocean. As evidence they referred to the emergence of fresh water from submarine depressions, to the presence of soluble rocks inshore from some of the valleys, and to the existence in some cases of depressions along the courses of valleys.

Possibly this explanation may apply to some submarine depressions, but most of the valleys show little resemblance to sink holes and are incised far too deeply to represent a sag in the roof of a cave. There are very few cases where the shore formations are of soluble material and also very few cases where the strike of the rocks is parallel to the trend of the submarine valleys. Finally, the great depth of the valleys below sea level makes it seem unlikely that they could be due to circulation of underground water coming from the lands.

[13] E. W. Galliher: Sediments of Monterey Bay, California, *Mining in California*, Vol. 28, 1932, pp. 42–79. See pp. 58–59 and Pl. III, facing p. 52.

[14] Henry Benest: Submarine Gulleys, River Outlets, and Fresh-water Escapes beneath the Sea-level, *Geogr. Journ.*, Vol. 14, 1889, pp. 394–413.

[15] W. S. T. Smith: The Submarine Valleys of the California Coast, *Science*, Vol. 15 (N.S.), 1902, pp. 670–672.

[16] Charles Gorceix: Le gouf de Cap-Breton, *La Géographie*, Vol. 37, 1922, pp. 401–411.

Continental Elevation and Changes of Sea Level

General opinion has attributed the valleys to subaerial erosion on temporarily uplifted continental borders subsequently drowned by submergence. Without the landslide supplement this explanation meets many difficulties. If the valleys had been recently submerged the continental shelves in their vicinity should be missing or of abnormal character. However, these shelves are decidedly normal and in an analysis of 100 cases were found to terminate at depths averaging 65 fathoms, which is very close to the average depth of shelf margins the world over. Also submergence should have caused the submarine valleys to penetrate deeply into the lands, whereas the great majority of them, except off glaciated regions, bear no relation to estuaries. Most of these valleys head close to a relatively straight stretch of coast (Fig. 3).

Fig. 4—The submarine valley off the Indus Delta. Each dot represents a sounding. The apparent straightness of the course of the bottom of the valley may be due to an error in coordination of the soundings lines which were taken well out of sight of the land.

Sea level must have been lowered by the formation of the great ice sheets; but as an explanation of submarine valleys it scarcely merits much consideration since most estimates indicate a change of the order of 300 feet, whereas all the valleys under discussion are much deeper. On the assumption that a relatively brief stand of the sea would allow the cutting of terraces in unconsolidated material and in soft rocks slightly below the temporary sea level, one finds evidence that the sea level of the Pleistocene might have been lowered as much as 400 feet,[17] not nearly enough to account for the valleys.

Other exceptional causes might be adduced in certain exceptional cases, but here we are seeking to explain the normal case of deep valleys cut through a well developed continental shelf.

Recent Origin of Valleys

However the valleys were formed originally, there are strong indications that in many cases their present condition is a recent

[17] Terraces at levels of about 70 fathoms are found along the shelf margins at many places.

development. Their steep sides are surely incompatible with long existence in a region of sedimentation. Their nearness to large deltas (Fig. 4) makes one wonder why they were not filled when the sea level was lowered by the great ice sheets. Preglacial valleys must have been at least in part reopened since the last glacial epoch. The amazing trench in the estuary of the Congo (Fig. 5), where

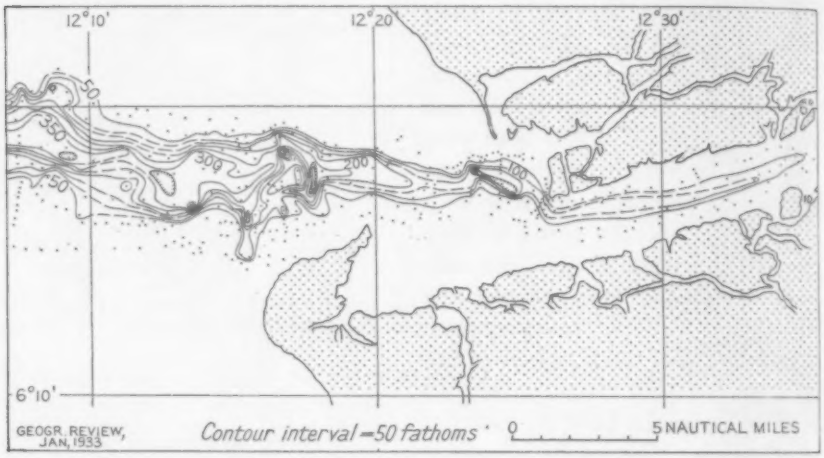

FIG. 5—The inner portion of the Congo trench showing how the depression enters the estuary at the mouth of the Congo River. Each dot of the water area represents a sounding.

deposition should be proceeding rapidly under the stagnant conditions reported for the bottom,[18] would appear to have developed in historical times. The Fosse de Cap Breton (Fig. 3), which occurs off the old mouth of the Adour River abandoned in the fourteenth century,[19] contains a muddy bottom despite the rapid drifting of sand along the coast. On the other hand, a comparison of two surveys off the California coast (Fig. 6) gives some evidence of a valley filling rapidly with sediment. A few centuries may eliminate the feature.

All of this leads one to wonder if the valleys are not still in process of formation. There is some evidence that this is actually the case. In 1929 movements accompanying the Grand Banks earthquake broke cables off Cape Breton Island and Newfoundland. A short time afterwards the steamer *Transylvania* reported that a part of the edge of the continental shelf outside the Gulf of Maine had dropped during the earthquake. The next summer the United States Coast Survey started the detailed charting of Georges Bank. Crossing the locality from which the change had been reported they found Corsair Gorge, which has been referred to above. It happens that this area is on one of the principal routes between Europe and New York. Since vessels commonly take soundings on approaching the conti-

[18] Cust, *op. cit.*, p. 181.
[19] Benest, *op. cit.*, p. 406.

nental shelf to determine their position, it is rather surprising that the valley, if it were there, had not been reported previously, especially in view of the study of the approaches to the shelf which Captain N. Johnsen made on the *Columbus* with an echo sounding machine just prior to the earthquake. According to his records he must have crossed the site of the valley many times with his sounding machine running, yet he found no evidence that it existed. The evidence is not conclusive, but highly suggestive, that the valley was at least greatly extended headward at the time of the earthquake. Fishermen report a similar development of a valley near Sable Island at this same time.

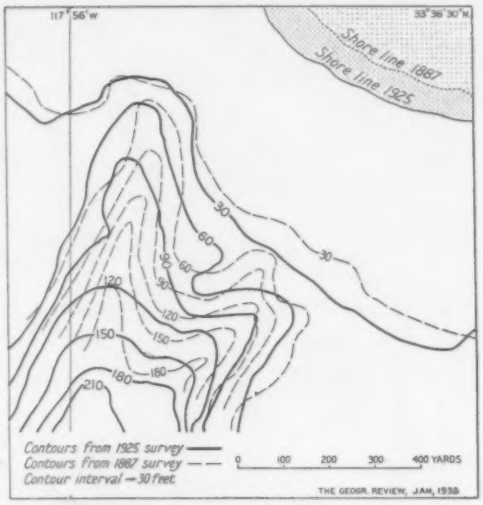

FIG. 6—Illustrating the partial filling of the inside of a submarine valley off Newport, Cal., during a lapse of 38 years.

Comparison of a survey in 1896 and of older soundings in an area off the River Esmeraldas, Ecuador, showed changes of bottom from "13 or 20 fathoms to upwards of 200 fathoms."[20] These soundings were close to shore and located by cross bearings, which should make their position fairly accurate. The soundings were made near the head of a submarine valley in which cables have been broken repeatedly and, at least in some cases, as a result of landslips.

Evidence that the bottom of Sagami Bay was considerably modified by the earthquake of 1923 was obtained by the Japanese from a comparison of old and new soundings.[21] The evidence for some of the modifications is not conclusive since a large part of the bay is so irregular that a resurvey might suggest changes whether they had occurred or not. However, there is one large area in the bottom of the Sagami Bay submarine valley where the soundings all show a large increase in depth.[22] It seems quite certain that the valley was deepened some time before the resurvey in 1923, and presumably the change occurred at the time of the earthquake. The changes amounted to hundreds of feet, whereas the greatest known fault movement accom-

[20] John Milne: Sub-Oceanic Changes, *Geogr. Journ.*, Vol. 10, 1897, pp. 129–146 and 259–289; reference on p. 263.

[21] Japanese Bureau of Waterways: Earthquake District Survey Report for 1923. Contains maps and profiles showing the changes.

[22] F. P. Shepard: Landslide-Modifications of Submarine Valleys, *Trans. Amer. Geophys. Union, Thirteenth Ann. Meeting, April 28 and 29, 1932*, Washington, 1932, pp. 226–230 and Figure 4.

panying an earthquake on land was only 47 feet. Furthermore, the submarine valley in Suruga Bay, which is well removed from the earthquake epicenter, showed evidence that it was also greatly deepened. Whether or not these valleys are the product of faulting, the sudden changes do not suggest diastrophic origin.

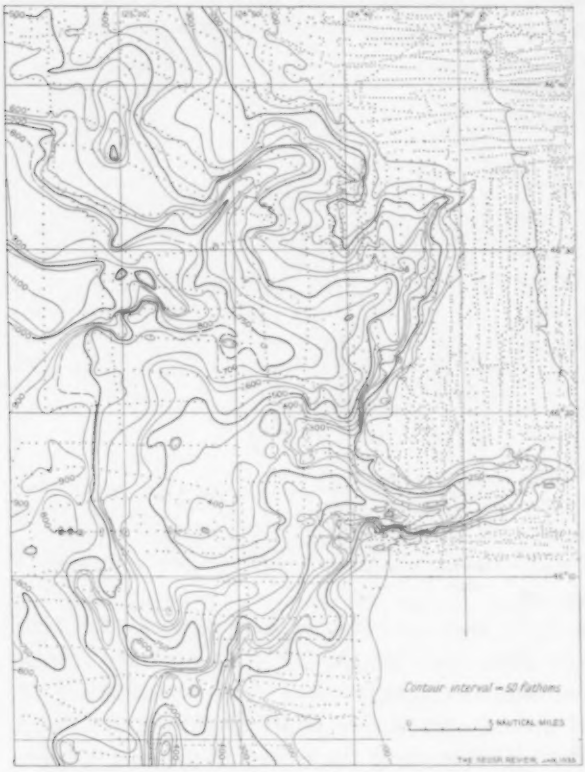

FIG. 7—The series of submarine valleys off the vicinity of the Columbia River, illustrating the hummocks and depressions characteristic of landsliding. Each dot represents a sounding.

LANDSLIDES

The outer part of the continental shelf presents an ideal situation for slides particularly of the mud-flow variety. The steep continental slopes beyond, the abundance of relatively fine saturated sediment, and the association of the valleys with seismic areas are all conducive to landslides. The long sinuous contour of the submarine valley is, however, decidedly different from the typical landslide cirque on land, which is commonly lunate. The difference may be explained by assuming that the submarine valleys are due to a combination of continental elevation, subaerial erosion, submergence, filling of the valleys, and finally reopening by landslides. Uplifts of the continents or at least of the continental margins during, let us say, some part of the Tertiary—perhaps different times for different places—would allow the rapid cutting of youthful valleys into the relatively steep continental slopes. The depressions into which these rivers drained might have extended well below the strand line of that time but might have been filled with the sediments from the new valleys, so it is hard to say whether the lower parts of the submarine valleys are of subaerial origin. However, some of them appear to show the characteristics of river valleys in depths of more than a mile. Most of the others

are poorly sounded in the depths in excess of about 3000 feet. With submergence and the development of stable conditions formation of the present continental shelves by a process of erosion and deposition would follow. During the course of the leveling the deeper

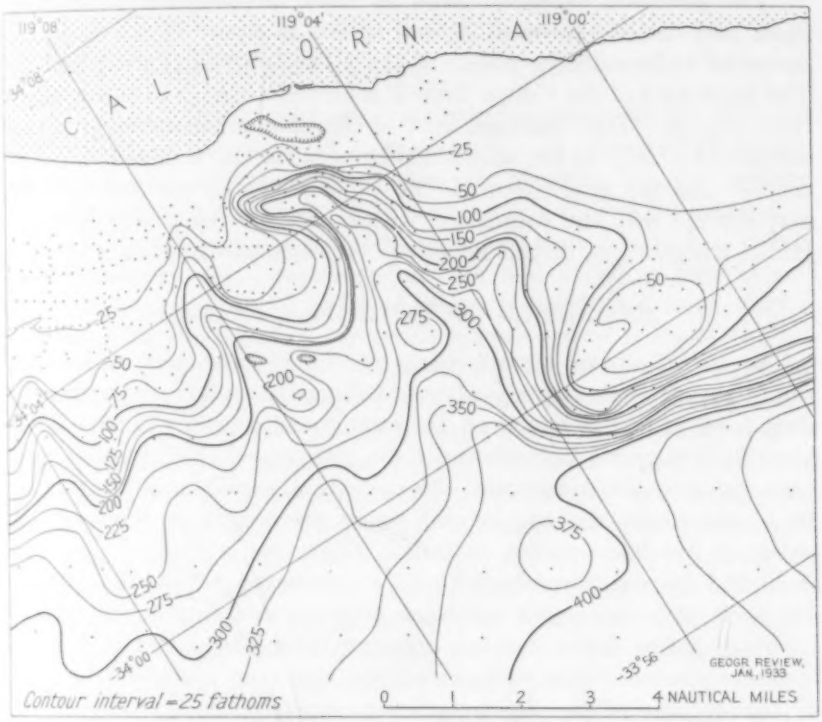

FIG. 8—Valleys off the coast of California, illustrating the cirque-like valley heads and hummocks at the mouths of valleys. Each dot of the water area represents a sounding.

parts representing the submerged valleys would fill with sediment unless some process kept them open. Because of the depth of the valleys this sediment would probably contain much clay and colloidal material, which if saturated is particularly subject to landsliding. Given impulse from an earthquake, the sediment might glide outward. In the interim those coast lines deeply indented by the submergence may have been straightened, and the landward remnants of many of the rivers have shifted their courses.

TESTS OF THE HYPOTHESIS

The character of the submarine valleys lends much support to the hypothesis that has been outlined. The resemblance of the depressions to river valleys has already been suggested, and many of them are related to the present-day large rivers, as in the case of the submarine valleys off the Indus, Ganges, Congo, Hudson, and Columbia.

In other places they are found off former drainage lines, as for example the Monterey Bay valley off the former outlet of the Great Valley of California,[23] the Fosse de Cap Breton off the former mouth of the Adour,[24] and the Canal de Nazare off the former mouth of the Tagus.[25]

The landslide evidence, such as basin depressions, hummocky base, and cirque-like head, is well shown in many of the carefully surveyed valleys off the coasts of the United States (Figs. 7 and 8). The inner part of the Congo Trench is also instructive in this connection (Fig. 5). The landward part of the submarine valley is not as subject to sliding as the seaward part because the sediment there is coarser and the gradient might be expected to be less steep. This may explain why the submarine valleys (except the Congo and the glacial trough type) do not penetrate the coast as estuaries.

Explanation of Valley-Free Shelves

As stated above certain parts of the shelves and continental slopes appear to be entirely without submarine valleys although very deep land valleys debouch on the contiguous coasts. The landslide hypothesis suggests an explanation for these cases. Valleys may have been cut into the continental slopes quite generally and later filled. In places where the continental slopes are gentle or terraced the sediment has less impetus to slide. The same is true in areas not disturbed by earthquakes. Rapid cementation where the valleys are filled with calcareous sediment may prevent future landsliding. In other places ocean currents running along the slopes may wear back the spurs between valleys until the slopes are equalized.

One or more of the above conditions applies to each of the known valley-free areas. For instance, off the southeastern United States south of Cape Hatteras the continental slope is terraced and the Gulf Stream follows the slope. The well charted continental slopes north of San Francisco show a remarkable relationship between terraced slopes and valley-less areas on the one hand and non-terraced slopes with valleys on the other. Off western Florida, northwestern Australia, and perhaps southern India, the lack of valleys may be a result of the calcareous sedimentation. The valley-free areas off the Yellow Sea and off the Gulf of Martaban[26] are explicable either on the basis of the rather gentle continental slopes or perhaps because the rim of islands beyond has ponded the waters from the shelves during times of continental elevation and thus prevented the cutting of valleys.

[23] H. W. Fairbanks: Oscillation of the Coast of California during the Pliocene and Pleistocene. *Amer. Geologist*, Vol. 20, 1897, pp. 213–245; reference on p. 234.

[24] Benest, *op. cit.*, p. 394.

[25] Personal communication from Professor Eduardo Hernández-Pacheco of Madrid.

[26] The Andaman Sea is reported as having submarine valleys (*Memoirs Asiatic Soc. of Bengal*, Vol. 9, 1925, pp. 1–25), but the evidence from the soundings is far from convincing.

In general, there appears to be no evidence to suggest that the uplift that is thought to have led to the original incising of the valleys by streams was not universal in extent. On the other hand, there is no reason to believe that this uplift occurred at the same time in different places.

Importance: Practical and Theoretical

A sounding in an uncharted submarine valley off the coast of California was the cause of a shipwreck. At present the coastal waters off California have been carefully charted, but the opening of new submarine valleys or the extension of old ones by landsliding might be the cause of other wrecks. It would seem advisable to follow in this country the Japanese procedure and make at least reconnaissance surveys of the adjacent ocean bottom after large coastal or submarine earthquakes. Possibly a resurvey of parts of the sea floor off California in those places where the last survey preceded an important earthquake might reveal landslide modifications.

Milne[27] has cited various cases where cables parted at the points where they crossed submarine valleys. In some cases the cables were deeply buried by landslide material and in other cases apparently left suspended by the sliding out of the material from underneath. The cable companies have observed that not all of these breaks are at times of earthquakes. In a case along the west coast of South America the breaks occur particularly at times of excessive rain.[28] There appear to be some interesting points for study regarding the character of the bottom where these breaks occur.

Aside from any practical significance that might come from the study of submarine valleys, they may throw some light on recent geological history. If we can establish their primary origin as true river valleys even in their outer portions, the magnitude of continental elevation and depression necessary to account for them would indicate a tremendous distortion of the earth's surface. We may be dealing with changes comparable to that which raised the Colorado plateau and with changes not on one or two coasts but along most, if not all, coasts of the world. If these have occurred, the effects on life migrations, on climate, and on all dynamic processes must have been tremendous.

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[27] Milne, *op. cit.*

[28] Personal communication from Commercial Cable Co.

GREAT CITIES OF 1930 IN THE UNITED STATES WITH A COMPARISON OF NEW YORK AND LONDON

Mark Jefferson

THE American public takes lively interest in the size of the city of New York. Is it larger than London? An odd sort of patriotic bias tinges the question. The answer is not easy to give. It is difficult to estimate the height of the atmosphere because it has no top—the air peters out. In the same way a great city thins out and comes to no definite limits.

Political New York is definite enough. It includes 299 square miles of territory within which in 1930 slept 4,736,883 inhabitants.[1] But the metropolitan district called by the census "New York-Northeastern New Jersey" covered 2514 square miles of territory and contained 10,901,424 persons. It includes nearly four times as much territory and twice as many persons as the metropolitan New York of the census of 1910. Each city is a New York, but which is New York? There are, in fact, as many New Yorks as you care to assign boundaries to. The boundary may be placed at various points with plausible reasons assigned for putting it at any of them.

It is the same with London. There is, for instance, a County of London with an area of 117 square miles and 4,396,821 persons. Then there is a Greater London, with 8,202,818 persons on 693 square miles; a municipal London, of the Lord Mayor, with one square mile of territory; and the London conurbation which "extends in several places beyond Greater London." No doubt if we pushed back the London boundaries to include 2514 square miles like "New York-Northeastern New Jersey," we should get many more than eight million inhabitants. Push it out to include the four Home Counties around the County of London, and we have over eleven millions. There are no natural limits to these great cities. But how then compare one with another in size?

Density of Population in a Metropolis

Before we can count the population of a great city we must define its boundaries. Political boundaries will not do if the place has active life and growth, because such boundaries have been adjusted to condi-

[1] On the consequences of census enumeration by residence or sleeping place see the writer's article "Distribution of the World's City Folks," *Geogr. Rev.*, Vol. 21, 1931, pp. 446–465; especially pp. 457–459.

tions of the past. It is a recognition of the inadequacy of legal boundaries of cities that impels censuses to lay out metropolitan districts. The United States census has been doing it since 1910. The method first used was to push back the political boundary ten miles in every direction and then readjust to the boundaries of the civil divisions that fell mostly within it, including every civil division that had more than 150 persons to the square mile. How the 1930 boundary has been made is described in the new bulletin on metropolitan districts (1932).[2] "In this census no such [ten mile] limit has been applied." All that is now insisted on is that every civil division included in the district have more than 150 persons to the square mile and that the total population of the continuous areas be more than 200,000. A density of 150 persons to the square mile means 40 families to a mile, 16 acres to a family. But that is farming density and not even intensive farming. Extensive farming is the customary occupation with densities from 125 to 250, more than 250 persons to the square mile becomes intensive farming or truck gardening. The writer's own conception of city densities begins at 10,000 to the square mile.[3] What such a density means is best seen by looking over the densities of the larger American cities (political boundaries) expressed to the nearest thousands: New York, 23; Chicago, 17; Boston, 18; St. Louis, 13; Detroit, 11; Cleveland, 13; Baltimore, 10; San Francisco, 15; Philadelphia, 15; Jersey City, 24.

The corresponding conception of the "Great City" is a closely built-up area—a continuous area of "brick-and-mortar" unity, to use Fawcett's phrase.[4] In this area there may be open parks for health and play but not open fields for agriculture. As an example of the way in which the boundaries of the metropolitan city may be worked out, the writer offers Detroit, with the local details of which he is familiar.

Boundaries of Metropolitan Detroit

The upper map of figure 1 is the census interpretation, the lower is the writer's. Cross shading designates political Detroit, the single-lined parts designate the regions that should be also included. The most striking feature of this map is the way Detroit has expanded along its four great cement highways since 1910, when the whole city lay south of Highland Park and Hamtramck, which are now enclaves of two independent municipalities within the political city of Detroit. The city outlined by the dotted lines is a fairly continuous mass of

[2] Fifteenth Census of the United States: 1930: Metropolitan Districts, Population and Area. Prepared under the Supervision of Clarence E. Batschelet, *U. S. Dept. of Commerce, Bur. of the Census*, Washington, 1932. The bulletin contains an immense amount of valuable data and useful maps for the study of urban population.

[3] The Anthropography of Some Great Cities, *Bull. Amer. Geogr. Soc.*, Vol. 41, 1909, pp. 537–566.

[4] C. B. Fawcett: Distribution of the Urban Population in Great Britain, 1931, *Geogr. Journ.*, Vol. 79, 1932, pp. 100–116.

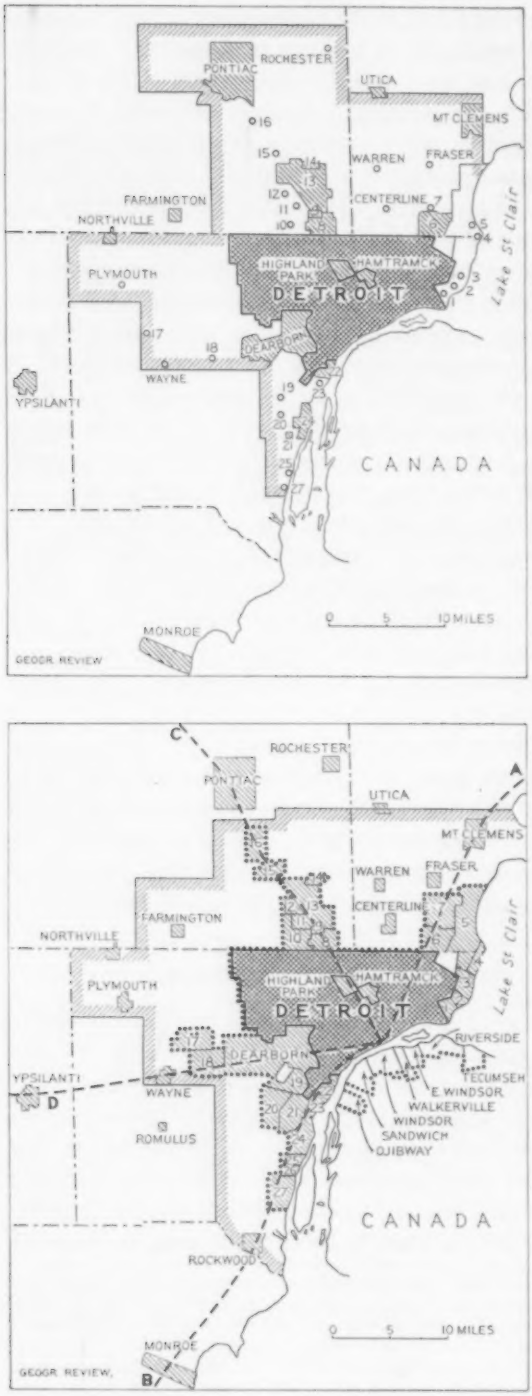

FIG. 1

close-built houses along paved streets, policed and served by a variety of municipalities. True, country fields and farms lie in the angles between the tentacles, off the principal lines of travel; but the ground is level, and there is a close network of cement roads. Island urban communities lie out in the fields, but they are isolated and are not counted in our conurbation. All the urban outliers that touch Detroit and each other are included.

There have been included also, with less assurance, the seven Canadian settlements along the Detroit River. They amount to but

FIG. 1—The conception of Detroit as a "great city": above, according to the United States Census; below, according to the author. The cross-hatched area is the political city, extensions of this area which should also be included in the political city are shown by single ruling; the band of shading defines the metropolitan district; the heavy dotted lines of the lower figures, "anthropographic" Detroit, and the heavy broken lines, the four great motor roads out of the city.

The numbers have reference: 1, Grosse Pt. Park; 2, Grosse Pt.; 3, Grosse Pt. Farms; 4, Grosse Pt. Shores; 5, St. Clair Shores; 6, Halfway; 7, Roseville; 8, Ferndale; 9, Pleasant Ridge; 10, Oak Park; 11, Huntington Woods; 12, Berkley; 13, Royal Oak; 14, Clawson; 15, Birmingham; 16, Bloomfield Hills; 17, Garden City; 18, Inkster; 19, Melvindale; 20, Allen Park; 21, Lincoln Park; 22, River Rouge; 23, Ecorse; 24, Wyandotte; 25, Riverview; 26, Sibley; 27, Trenton.

113,000 persons in all. If the river were vital to Detroit, as it once was, the Canadian settlements would be more truly urban, more important and more essential parts of Detroit. It is precisely in these years of diminishing long-way use of the lakes for all but through traffic in ores, coal, and grain that transverse road and railway traffic has demanded two tunnels and a bridge across the river to help the ferries handle increasing loads. For longway traffic the Detroit River is an artery of life, for crossway traffic an obstacle to be overcome. This Detroit of the writer's map has 1,989,000 inhabitants. The Detroit of the census has 2,105,000.

TABLE I—THE GROWTH OF NEW YORK

In Thousands

	1890	1900	1910	1920	1930
Manhattan	1441	1850	2332	2284	1867
Brooklyn	838	1167	1634	2018	2560
Bronx	89	201	431	732	1265
Queens	87	153	284	469	1079
Richmond	52	67	86	117	158
Yonkers	32	48	80	100	135
Mt. Vernon	11	21	31	43	61
New Rochelle	8	15	29	36	54
Jersey City, N. J.	163	214	268	298	317
Hoboken, N. J.	44	59	70	68	59
Bayonne, N. J.	19	33	56	77	89
Union City, N. J.	11	15	21	21	59
North Bergen, N. J.	....	9	16	23	41
West New York City, N. J.	....	5	13	30	37
Total	2795	3857	5351	6316	7781
Population New York	2207	3407	5067	6169	7781

BRICK-AND-MORTAR NEW YORK

The 1930 census gave the New York-Northeastern New Jersey metropolitan district a total of 10,901,424 persons. But from a quarter to a third of this number are rural or small-town folk. Evaluating New York as a metropolis of dwellers in a continuous region of high buildings, paved streets, police, sewers, lights, great wholesale houses, corporation headquarters, trust companies, publishing houses, hotels, museums, theaters, universities, and libraries, the writer finds 7,781,000 inhabitants really large-city dwellers. The composition of this unit is in the last column of Table I, which also illustrates the growth of the conurbation and its separate constituents in preceding decades.

The totals for the several constituents are not the same as the

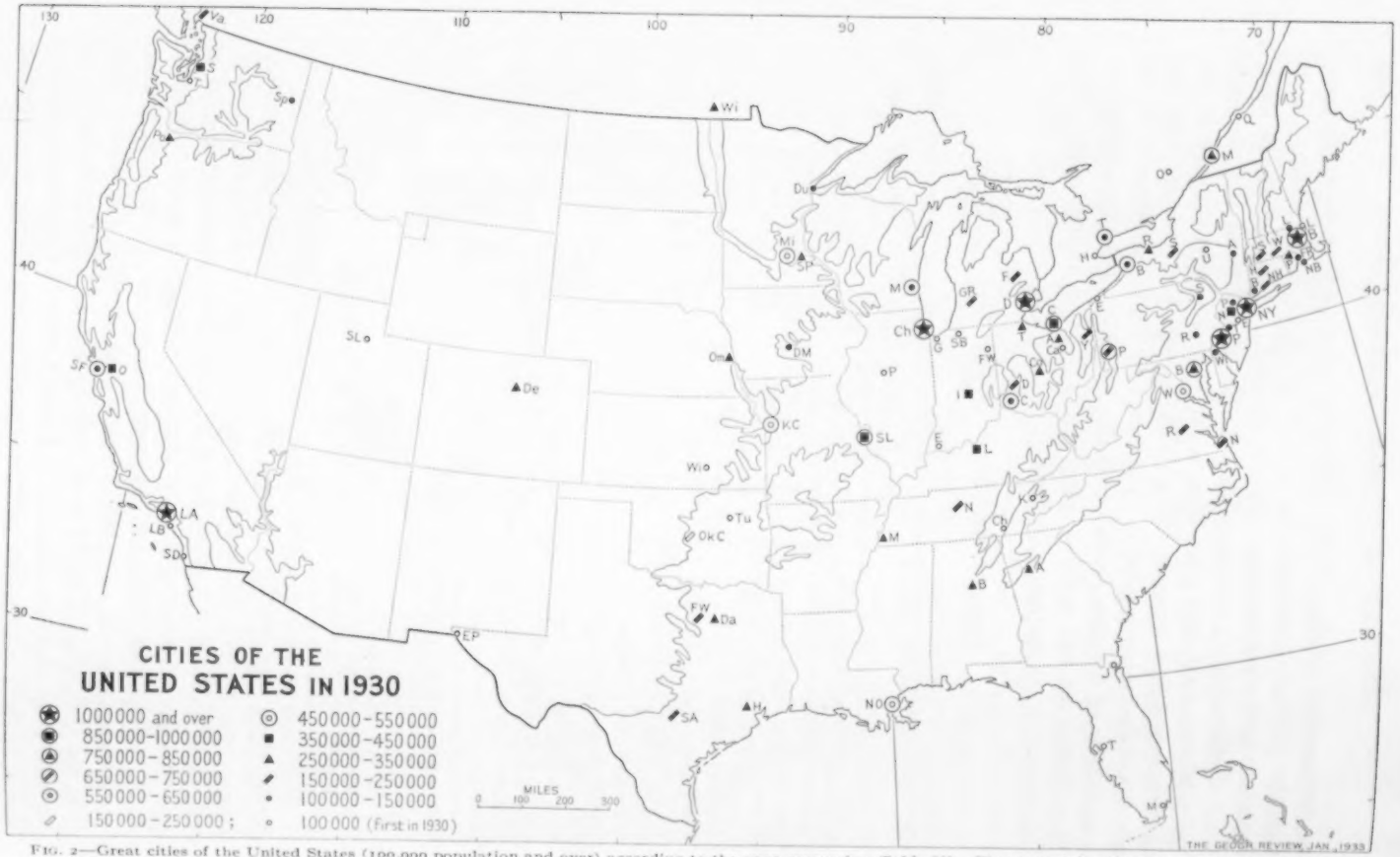

FIG. 2—Great cities of the United States (100,000 population and over) according to the 1930 census (see Table II). Places attaining this category for the first time in 1930 are shown by an open symbol. Canadian cities have been added according to the census of 1931. Note distribution in regard to elevation as shown by the addition of the 1000-foot contour line. Compare with the map of great cities in 1920 (*Geogr. Rev.*, Vol. 11, 1921, p. 439).

1930 are shown by an open symbol. Canadian cities have been added according to the census of 1931. Note distribution in regard to elevation as shown by the addition of the 1000-foot contour line. Compare with the map of great cities in 1920 (*Geogr. Rev.*, Vol. 11, 1921, p. 439).

TABLE II—GREAT CITIES OF THE UNITED STATES, 1930

In Thousands

New York,* N. Y.	7781	St. Paul, Minn.	272	Salt Lake City, Utah	140
Chicago, Ill.	3374	Atlanta, Ga.	270	Paterson, N. J.	138
Philadelphia,* Pa.	2083	Dallas, Tex.	260	Duluth,* Minn.	138
Detroit,* Mich.	1989	Birmingham, Ala.	260	Jacksonville, Fla.	130
Los Angeles, Cal.	1238	Omaha,* Neb.	256	Albany, N. Y.	127
Boston,* Mass.	1140	Akron, Ohio	255	Trenton, N. J.	123
Cleveland, Ohio	900	Memphis, Tenn.	253	Chattanooga, Tenn.	120
St. Louis,* Mo.	896	Providence, R. I.	253	Erie, Pa.	116
Baltimore, Md.	805	San Antonio, Tex.	232	Spokane, Wash.	116
Pittsburgh,* Pa.	738	Norfolk,* Va.	210	Fall River, Mass.	115
San Francisco, Cal.	634	Syracuse, N. Y.	209	Fort Wayne, Ind.	115
Buffalo,* N. Y.	597	Dayton, Ohio	201	Elizabeth, N. J.	115
Cincinnati,* Ohio	580	Worcester, Mass.	195	New Bedford, Mass.	113
Milwaukee, Wis.	578	Oklahoma City, Okla.	185	Reading, Pa.	111
Kansas City*	522	Richmond, Va.	183	Wichita, Kan.	111
Washington, D. C.	487	Youngstown, Ohio	170	Miami, Fla.	111
Minneapolis, Minn.	464	Grand Rapids, Mich.	169	Tacoma, Wash.	107
New Orleans, La.	459	Hartford, Conn.	164	Wilmington, Del.	107
Newark, N. J.	442	Fort Worth, Tex.	163	Knoxville, Tenn.	106
Oakland,* Cal.	421	New Haven, Conn.	163	Peoria, Ill.	105
Seattle, Wash.	366	Flint, Mich.	156	Canton, Ohio	105
Indianapolis, Ind.	364	Nashville, Tenn.	154	South Bend, Ind.	104
Rochester, N. Y.	328	Springfield, Mass.	150	El Paso, Tex.	102
Louisville,* Ky.	320	San Diego, Cal.	148	Lynn, Mass.	102
Portland, Ore.	302	Bridgeport, Conn.	147	Evansville, Ind.	102
Houston, Tex.	292	Scranton, Pa.	143	Utica, N. Y.	102
Toledo, Ohio	291	Des Moines, Iowa	142	Tampa, Fla.	101
Columbus, Ohio	291	Long Beach, Cal.	142	Gary, Ind.	100
Denver, Colo.	288	Tulsa, Okla.	141	Lowell, Mass.	100

*Indicates a composite city or conurbation.

population of the New York conurbation of the period because, while today the five boroughs and nine municipalities make a fairly continuous city around the harbor of New York, they did not do so forty years ago. They were then mostly discontinuous population nuclei.[5] Unlike the census bulletin the writer does not include Paterson and Newark in the New York conurbation. If at some time in the future the docks of Newark become a terminal for foreign commerce continuous and alternative with those of Manhattan and Jersey City, Newark will then have become geographically a part of the great city of New York.

New York and London

Professor Fawcett estimates that the London of brick-and-mortar unity in 1931 contained 9,150,000 inhabitants.[6] That is probably the best estimate that can be made at the present time for London. To the estimate I have made for New York, perhaps another five per cent—certainly not more—should be added for small fringing areas not taken into account and 160,000 for an additional year's growth, to bring it up to the English date 1931. That would give what is probably an outside total of 8,330,000 to be compared with the London of 9,150,000. London is still a considerably larger city than New York by night, as censuses count city population. In the daytime, with workers of many kinds added from outlying regions, New York may possibly be as large as London, but this is not known.

American Great Cities of 1930

Applying the criteria used for determining the conurbations of New York and Detroit the writer finds that there were in 1930 eighty-seven great cities—of more than 100,000 persons each—in the United States, thirteen more than in 1920.[7] The United States Census of 1930 listed ninety-six metropolitan districts. Six of the cities included should not, however, be counted as separate entities, being essentially parts of certain of the eighty-seven here listed; Jersey City and Yonkers of New York, Camden of Philadelphia, Cambridge and Somerville of Boston, and Kansas City, Kan., one with Kansas City, Mo. Several places listed in the census bulletin are not metropolitan at all. The city idea is inherent in the word metropolis itself. If places are not great cities they are not metropolitan. What could be less metropolitan than Atlantic City, Lancaster, Pa., Little Rock, Ark., Roanoke, Va., San Jose, Cal., and Wheeling, Charleston, and Huntington, W. Va.—all listed by the census?

[5] On the New York of 1900 see article cited in footnote 3.

[6] *Op. cit.*

[7] Mark Jefferson: Great Cities of the United States, 1920, *Geogr. Rev.*, Vol. 11, 1921, pp. 437–441.

The eighty-seven great cities are listed in Table II and are shown on the map, Figure 2, to which have been added the great cities of Canada (1931), seven in number.

For the first time in the history of the United States the decade 1920–1930 has seen great cities lose population. The four cities and

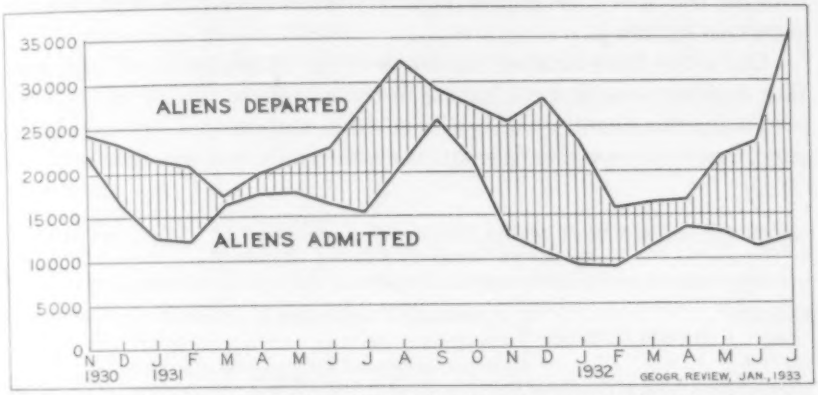

FIG. 3—Migration currents to and from the United States were reversed in November, 1930, when the number of aliens departing first exceeded the number admitted. The graph shows the population thus lost to the United States.

their losses (units) are Lowell, 12,525; New Bedford, 8620; Fall River, 5211, in Massachusetts; and Wilmington, 3571, in Delaware. That such a thing never happened before, that every city to attain hundred-thousand size in the 128 years since New York first reached it has continued increasing in size until the decade 1920–1930 is a remarkable record. Albany did fall back from 94,923 inhabitants in 1890 to 94,151 in 1900, but she had not then quite grown into a great city. Smaller places have fallen back in several cases.

In general a city attains hundred-thousand size by rendering services, and the vital momentum due to men who render those services keeps those cities growing. Natural resources may be exhausted, a temporary advantage may be lost; but the men who exploited resources and used their advantages may be counted on to look around for new tasks when old ones are worked out. The three Massachusetts cotton cities have seen some of their work shifted to the South. Manchester, N. H., shared the drop, 78,384 in 1920 and 76,834 in 1930; but other towns not especially concerned with cotton were affected in the same way.

A Turning Point in Population Growth

The fact is a turning point has been reached in growth of population in the United States. In the seventh decade of its history, 1850–1860, nearly 36 per cent was added to the population, but since that time the increment has been smaller in every decade except the last when

it was slightly greater. For 1910–1920 the increment was 14.9 per cent; for 1920–1930, 16.1 per cent.[8] The fifth doubling of the country's population was completed July 20, 1930, and took a little more than 41 years, almost twice as long as the first doubling, completed in 1812. The birth rate steadily falls, and immigration currents—also for the first time in our history—are reversed, as is graphically shown in Figure 3.

Our cities have received so much of our immigration of late years that they are sensitive to changes in the numbers. When unemployed men leave this country they go from cities, and news of city unemployment deters prospective immigrants who would mostly settle in cities.

TABLE III—GROWTH OF GREAT CITIES AND PROPORTION OF TOTAL POPULATION IN GREAT CITIES BY CENSUS DIVISIONS

NUMBER OF CITIES	CENSUS DIVISION	AVERAGE PERCENTAGE OF GROWTH				PERCENTAGE OF TOTAL POPULATION
		1890–1900	1900–1910	1910–1920	1920–1930	
11	New England	37	29	21	3	32.3
15	Mid-Atlantic	23	27	20	12	49.4
9	South Atlantic	50	69	91	52	15.0
6	East South-Central	32	63	37	56	13.0
8	West South-Central	51	355*	89	65	15.0
19	East North-Central	41	41	64	33	39.5
8	West North-Central	35	46	28	18	21.1
2	Mountain	22	66	24	16	11.6
9	Pacific	56	171	55	42	41.0

*But for Tulsa and Oklahoma City, boomed by oil, this figure would have been only 100.

COMPARATIVE GROWTH OF GREAT CITIES

Twenty-six cities of the Atlantic border increased only 8 per cent each in this decade, against 21 per cent in the decade before. The northeastern part of the country had the smallest city growth. In no other part of the United States did a great city fail to gain 10 per cent, with the one exception of St. Louis, which gained 7 per cent against 12 the decade before. The eastern cities that increased less than 10 per cent were Boston, Providence, Worcester, New Haven (only 118 persons more in 1930 than in 1920), Bridgeport, Lynn, Philadelphia, Scranton, Paterson, Newark, Trenton, Reading, Utica, Baltimore, Richmond, and Norfolk.

In the south and west, however, six cities more than doubled in size. Miami, Fla., 270 per cent—500 per cent the decade before—, Chattanooga, Houston, Oklahoma City, Los Angeles, and San Diego, in regions most remote from the old seat of industry in the northeast.

[8] For an exact ten-year period, however, these numbers are 15.5 and 15.7 respectively.

Table III sets forth the facts of growth of great cities and also in the last column presents the proportion of great-city dwellers. It will be noted that practically half the people of the Mid-Atlantic states live in great cities, more than a third in the Pacific and East North-Central divisions, nearly a third in New England, and only from a tenth to a fifth in the rest of the country.

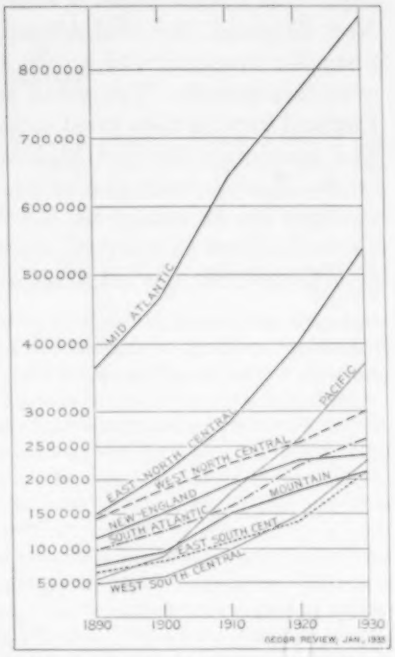

FIG. 4—Graphs of the population of the average city for each census division of the United States for 1890, 1900, 1910, 1920, and 1930.

Only the East South-Central cities increased faster than in the decade before. Percentage figures for 1910–1920 and 1920–1930 respectively are Louisville 9, 60; Birmingham 35, 45; Memphis 24, 56; Nashville 7, 30; and Chattanooga 29 and 107. Knoxville's rate, however, diminished from 119 to 36 per cent.

No city in New England grew as much in the twenties as in the teens of the century, and in the Mid-Atlantic region only New York (18, 23) and Pittsburgh (11, 13). In the South Atlantic division we have gains in Atlanta (30, 34) and Tampa (37, 94); in the West South-Central, in New Orleans (14, 19), Houston (75, 110), Oklahoma City (43, 103), and Fort Worth (45, 54). Four cities of the East North-Central also increased at an accelerated rate: Milwaukee (22, 26), Cincinnati (11, 13), South Bend (32, 46), and Peoria (13, 51); but Chicago could not quite keep up (28, 25). In the West North-Central region St. Paul (9, 16) and Wichita (39, 54) excelled their record, and in the Pacific states so did San Francisco (21, 25), San Diego (78, 100), and Spokane (0, 11)—in all, twenty-one of the eighty-seven cities of the country managed to better previous growth.

Such a comparison of rates of growth must not mislead us as to actual growths, which were greatest in the northeast, where the cities are so much larger. New York's 23 per cent growth consisted of 1,460,000 persons added in the decade; Oklahoma City's growth of 110 per cent only meant 154,000. The diagram of the *average city* of each region makes this clear. Thus 19 great cities of the East North-Central states in 1890 had a total of 2,771,000 inhabitants, or a mean city of 148 thousand, 210 thousand for 1900, 285 thousand for 1910, 398 thousand for 1920, and 526 thousand for 1930.

On these graphs actual growth is indicated by steepness of line, hesitancy of growth by convexity of the line upward. This hesitancy is most pronounced for New England. Concavity upward shows vigor of growth, best exemplified by the mean West South-Central city. The Pacific shows it strikingly except for the inflexion of 1910. New England, the Mid-Atlantic, and the Pacific districts all show a smaller proportion of great-city dwellers, which is a new condition with this decade. Ten years ago 34 per cent of the people of New England lived in their great cities, now only 32.3 per cent live in them. The percentage for the Mid-Atlantic has fallen from 50.2 to 49.9, for the Pacific from 41.4 to 41.0. In each case the number of city dwellers has increased, in the Mid-Atlantic by nearly two million, but not as fast as the population of the region grew. Actual exodus from great cities has been limited to the four cities named.

DANZIG AND GDYNIA

Eugene Van Cleef
The Ohio State University

ON the southern shores of the Baltic only a few miles apart stand two of the great ports of that sea—Danzig and Gdynia. In other respects they are far apart. What greater contrasts could be conceived than those that lie between the old Hanse town with six centuries of notable economic history behind it and the Polish port, twelve years ago a fishing hamlet? The new rivalry marks for Danzig the latest phase of a career in the shaping of which political geography has played a strong part.

Danzig has been a storm center of rival aspirants since the fighting order of Teutonic Knights acquired control in 1308. When that control was shaken off a century and a half later, Danzig became nominally a protectorate of Poland and so remained until the partitions. The conclusion of the Napoleonic wars found Prussia the successful claimant for the city, against the Russian ambition to secure the entire Vistula Basin, with Danzig its key. In the often-quoted words of Frederick the Great, "He who possesses the bed of the Vistula and Danzig is more the master of the country than the King who reigns there." It was to provide an outlet for Poland and thus make economically effective the acquisition of the "bed of the Vistula" by a politically independent Poland that the Treaty of Versailles and subsequent conventions declared Danzig a free city in 1920. In consequence much controversy has risen between German and Polish interests bearing on the legality and ethics of operations of the authorities seated at Danzig and Warsaw. Out of the situation an important literature has developed containing much of interest to the geographer. It is with this that the present discussion is concerned.

Danzig as a Harbor

The natural site of Danzig originally lacked many qualities desirable in a first-class modern port,[1] but its location upon the Vistula delta warranted the German people in applying a large expenditure of money and energy to endow it with those elements that nature failed to provide. By the dredging of the Mottlau River, which flows into the Vistula at a point about seven kilometers from the sea and the canalizing in part of the Vistula itself, the navigability of the harbor was greatly improved. The distributary of the Vistula is here known locally as the "Tote Weichsel" or dead Vistula—an accurate description of its essentially currentless waters.

The Vistula empties into Danzig Bay at three different places. Its original mouth was located at the present port site; a later outlet was formed February 1, 1840, by an ice jam at a point about 10 kilometers to the east, at Neufahr, and a third outlet as far again to the eastward, at Schiewenhorst, was carved by man and completed in 1895.[2] The purpose of providing this last-mentioned outlet was to release through a short route to the sea ice jams and spring freshets and so afford protection against widespread flooding over the delta lands. Thus the harbor channels at Danzig are practically free from silting, and dredged areas are easily main-

[1] For a brief account of the growth of Danzig see F. Froese: Die Entwicklung des Danziger Stadtbildes, *Der Nordosten*, Vol. 1, Breslau, 1931, pp. 155–167.

[2] *Beiträge zur Natur- und Landeskunde der Freien Stadt Danzig*, Ser. 1, No. 9. Aus unserer Sammelmappe vom Statistischen Landesamt der Freien Stadt Danzig, Danzig, 1925.

tained at desired depths. Locks prevent fluctuations in level of water in the Vistula from being transferred to the harbor proper.

The harbor at Danzig is one of the deepest in Europe, having a maximum depth of 9.5 meters. Turning basins are not as large as desirable; although the river width, ranging from 60 to 135 meters, inclusive of slips, provides satisfactory conditions for most ships. The length of quays approximates 30 kilometers, and abundant area remains for easy expansion as the needs of the port require. Equipment for the efficient handling of all kinds of goods is being rapidly improved.[3]

Pre-War Traffic through Danzig

Prior to the World War the port faced competition with other Baltic ports and with German North Sea ports. Stettin was its principal rival because overland transportation facilities between western Poland, pre-war Germany, and Stettin were better than those between this same region and Danzig. Again, the port of Stettin was better equipped and afforded a more diverse ship service. Even so, the traffic through Danzig was considerable. The data in Table I present a review of the pre-war traffic at Danzig. The steady increase in tonnage up to 1912, both by sea and river, is evident. The greater part of this tonnage included grain and lumber for export.

Table I—Tonnage at the Port of Danzig[4]

Average Annual	Ocean Traffic (tons)	Vistula Traffic (tons)
1881–1885	977,000	300,500
1886–1890	1,004,700	322,800
1891–1895	1,135,300	422,400
1896–1900	1,444,600	471,200
1901–1905	1,477,800	437,600
1906–1911	1,905,000	491,800
1912	2,453,212	610,300
1913	2,112,101	597,300

The amount of traffic on the Vistula is particularly impressive in view of the fact that the flow of water has been regulated for navigational purposes only in that section of the river formerly included within Prussia. Furthermore, during much of the nineteenth century, Danzig was handicapped by a tariff[5] between Russia and Germany resulting from time to time in severe reductions in traffic. For example, when in 1893, as a retaliatory measure Germany levied a general 50 per cent tariff on Russian goods and a special tax of 7½ marks on every 220 pounds of bread grains, the trade of Danzig almost came to a standstill. Again in 1905 a new tariff arrangement levied on specific grains resulted, by 1907, in another decline in the receipt of Russian wheat and rye tonnage. Fortunately for Danzig this situation did not obtain long, for freight rates were promptly adjusted on general grains, placing this and other German Baltic ports in a trading position comparable with that of the former Russian ports of Riga and Liepāja (Libau).

[3] A good presentation of the physical and technical development of the port of Danzig occurs under the heading "Danzigs Hafen und seine Entwicklung" by Dr. Willi Quade in *Verhandl. und Wissenschaftliche Abhandl. des 24. Deutschen Geographentages zu Danzig*, Breslau, 1931, pp. 141–161.

[4] Wirtschaftspolitische Stellung und Weltwirtschaftliche Bedeutung der Freien Stadt Danzig. *Danziger Wirtschaft und Statistik*, No. 1, Danzig, 1923, p. 22.

[5] Adam Tomas: The "Polish Corridor" and Peace, Warsaw, 1930.

Little of Danzig's grain freight seems to have originated in the Polish part of old Russia. The former dependent state was largely transit territory, as indicated by the following figures:[6]

	Imports into Poland Poods (36.1 lbs.)	Exports from Poland Poods (36.1 lbs.)
1907	25.7 million	26.5 million
1909	26.3 "	29.6 "
1910	36.1 "	26.0 "

The economic hinterland of Danzig in pre-war years included a considerable portion of eastern Germany which is now a part of Poland. The remainder of present Poland was likewise within the natural hinterland of the port. The provinces of West and East Prussia, Posen, and in part Pomerania were the sources of strength for the growing trade activities of Danzig.[7] Even the Ukraine supplied freight, in particular grain and sugar. In 1912 Russia shipped to this port for export 208,000 tons of grain and 128,000 tons of sugar, products that rank in importance next after lumber, the leading export commodity.

Post-War Traffic through Danzig

Upon the termination of the World War and the subsequent realignment of boundaries the political character of the Danzig hinterland was totally changed.[8] However, in the Paris Convention of November 15, 1920, and the Warsaw agreement of October 24, 1921, Poland in essence promised the trade and industrial interests of Danzig freedom of movement within her domain. Furthermore, in the matter of tariff laws and tariffs Poland agreed "to protect the interests of the Free City of Danzig so far as possible" and in reference to railroad freight rates "to take into account the requirements of Danzig's economic life as well as to promote her competitive possibilities with respect to other harbors."[9]

Considerable confusion exists in the statistical data for the commerce of both Danzig and Poland owing to the fact that since January 1, 1922, the Free City of Danzig has not only been included within the customs districts of Poland but has been subjected to identical tariffs. The immediate administration of the customs laws and levies is under the jurisdiction of Danzig officials who work jointly with the Polish customs officials. In the event of disputes, appeal may be made to a High Commissioner, who is a representative of a nation that was neutral during the war. However, he serves only as arbiter and has no power beyond this function. Appeal from his decision may be made to the League of Nations. In view of this overlap in administration, it is a difficult matter to differentiate exactly between transit traffic arising out of the trading activities of organizations located in Poland and traffic stimulated by traders in Danzig which is handled by the latter for reshipment to Poland or on Polish account to foreign buyers. Such data as are offered must be

[6] *Danziger Wirtschaft und Statistik*, No. 1, 1923, p. 28.

[7] Karl Halfar: Danzig und Gdingen, *Erde und Wirtschaft*, Vol. 5, 1931, pp. 6–14; reference on p. 7.

[8] Dr. N. Crentzburg effectively develops the relationship between the natural hinterland and the economic hinterland of Danzig in his recent paper "Danzig und sein Hinterland," *Verhandl. und Wissenschaftliche Abhandl. des 24. Deutschen Geographentages zu Danzig*, Breslau, 1931, pp. 131–140. He shows how a natural hinterland like that of Danzig, which spreads over a number of different nationalistic units, may be progressively shrunk by political and economic factors. He also distinguishes between the export and the import hinterlands respectively, based upon the radical differences in the nature of the products involved.

[9] Halfar, *op. cit.*, p. 7.

accepted largely as indicative of trends rather than as representative of conditions in absolute terms. Again, in the post-war period so many variables have affected the movement of goods that comparisons either with pre-war trade or among successive years within the post-war period demand great caution. However, one may venture certain general conclusions.

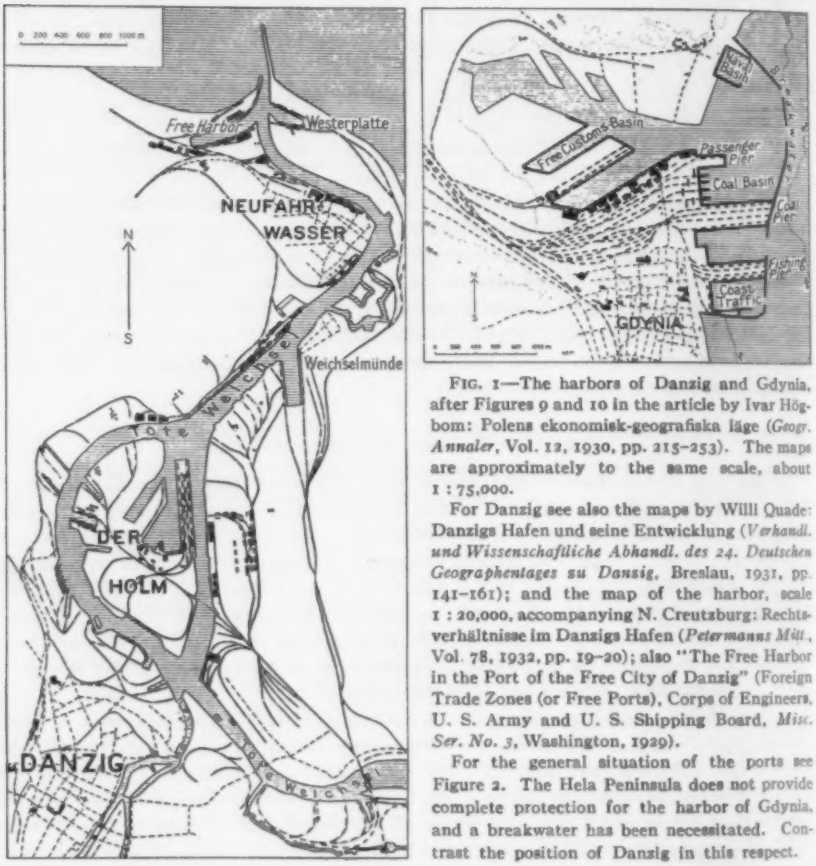

FIG. 1—The harbors of Danzig and Gdynia, after Figures 9 and 10 in the article by Ivar Högbom: Polens ekonomisk-geografiska läge (*Geogr. Annaler*, Vol. 12, 1930, pp. 215–253). The maps are approximately to the same scale, about 1 : 75,000.

For Danzig see also the maps by Willi Quade: Danzigs Hafen und seine Entwicklung (*Verhandl. und Wissenschaftliche Abhandl. des 24. Deutschen Geographentages zu Danzig*, Breslau, 1931, pp. 141–161); and the map of the harbor, scale 1 : 20,000, accompanying N. Creutzburg: Rechtsverhältnisse im Danziger Hafen (*Petermanns Mitt.*, Vol. 78, 1932, pp. 19–20); also "The Free Harbor in the Port of the Free City of Danzig" (Foreign Trade Zones (or Free Ports), Corps of Engineers, U. S. Army and U. S. Shipping Board, *Misc. Ser. No. 3*, Washington, 1929).

For the general situation of the ports see Figure 2. The Hela Peninsula does not provide complete protection for the harbor of Gdynia, and a breakwater has been necessitated. Contrast the position of Danzig in this respect.

Danzig has complained that post-war political changes have affected its trade and therefore its well-being. Polish authorities argue that the change was beneficial and involved merely a shift in the kinds of commodities handled. Whereas sugar and wheat exports declined below pre-war levels, increases occurred in textiles, paper, metal manufactures, and still other goods (see Fig. 3).[10]

The question of relative benefits presumably is debatable. The major traffic of the port both in pre-war and post-war years has been for the account of territory now under Polish jurisdiction, formerly divided between Germany and Russia. Increases in imports of ores, chemical products including fertilizers, and foodstuffs reflect apparently a relatively larger post-war than pre-war economic hinterland. Sundries, however, show a marked decline, probably due in part to increased production and the establishment of new industries within Poland.

[10] Reply of the Polish Government to the Application submitted by the Government of the Free City of Danzig to the High Commissioner of the League of Nations, Danzig, July, 1930. Published by the Government of the Free City of Danzig, Danzig, 1931.

The decline in exports of cereals and sugar, products said by Danzig authorities to rank with timber as the most profitable freight handled in the port, is clear. Timber in 1928 began to show a decline also, but it was still well above pre-war figures. The enormous increase in coal exports is to be attributed to the British coal strike effective in 1926. Comparison of export and import totals in the post-war years reveals the dominance of timber and coal among the exports in contrast with a diversified list of products making up the imports. In fact, if timber and coal be excepted, the tonnage in 1927–1928–1929 of exports of all other goods falls far below that of imports. The ratio under these conditions between exports and imports becomes about one to three. This is in strong contrast with the pre-war balance which, even excepting timber, was generally well maintained.

Ship entrances and clearances in Danzig harbor, both less than a million tons in 1913 (the rate of increase in pre-war years had been small: 1913 actually showed a decline from 1912), show a marked rise in post-war years from less than a million tons (1920) to four millions (1928). While ships did not always bring or carry away full cargoes, the marked increase in tonnage is indicative both of the availability of ship service to the port and the growing attraction of the port for cargo carriers. Of course, sight must not be lost of the fact that coal and ore movements played an important part in filling ship holds, whereas miscellaneous cargo declined.

Between 1924 and 1929 ores, metals, and metal manufactures rose from 13.8 per cent of the total import cargo to 61.7 per cent, while fuel rose from 4.7 per cent of the export cargo to 79.5 per cent. Timber, second in rank to coal as a Polish export, dropped from 62.2 per cent of the total in 1924 to 9.8 per cent; but timber and coal together since 1924 have totaled over 75 per cent of the exports. In 1928 they reached a peak of 93.1 per cent.

FIG. 2—Danzig and Gdynia and the Upper Silesia-Gdynia Railway planned to give an all-Polish route into the hinterland. Completion of the line was expected by the beginning of 1933. Scale of map 1 : 4,800,000.

THE FOREIGN TRADE OF POLAND

The percentage of Poland's total trade represented by her oversea trade has risen steadily from 8 per cent in 1923 to 44 per cent in 1929.[11] This increase has been due to a number of factors. In the first place nationalistic animosities between Germany and the newly created autonomous Poland, already at fever heat at the conclusion of the war, were intensified by the creation of the "Polish Corridor" and the Free City of Danzig. Thus there arose a spirit of trade avoidance between the two countries so far as this was practicable. Then too, the respective governments have been unable to agree on a commercial treaty. Again,

[11] Collection of Documents regarding the Application submitted by the government of the Free City of Danzig to the High Commissioner of the League of Nations, Danzig, for a Decision in the Matter of Danzig-Gdingen, p. 206.

Poland's policy of making direct contact with oversea nations, instead of trading by way of German seaports, encouraged shipments in the direction of Danzig. Finally, Poland undertook the construction of a new port within her own territory—Gdynia (Gdingen in German).[12] Doubtless this is what a Swedish writer has in

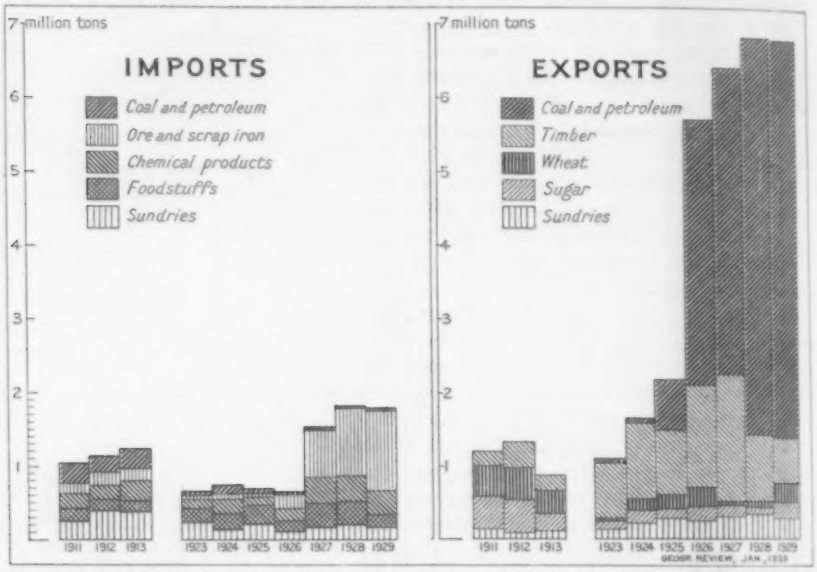

FIG. 3—Graph showing imports and exports through Danzig. After the work cited in footnote 11.

mind when he says "Poland has become a Baltic state in a higher degree than is justified by her geographical configuration and position alone."[13]

Various reasons for building the port of Gdynia, work on which was begun in 1920, have been cited.[14] At first, the prohibition of Danzig as a naval base by the terms of the Versailles Treaty necessitated the establishment of a base on Polish territory if Poland was to be free to develop a navy. Further arguments are presented by Polish interests to the effect that the capacity of the port of Danzig "became insufficient for Polish needs"[15] when Polish sea-borne foreign trade began to increase rapidly. As evidence that the creation of this port was dictated by "the economic necessities of Poland," comparative traffic data for Danzig and Gdynia are cited.

GDYNIA AS A PORT

The site of the harbor of Gdynia on Danzig Bay is favorable because of protection from storm waves offered by the Hela Peninsula, a sandy sea bottom, roominess, a minimum of required dredging to secure ample depth, little silting, relatively infrequent freezing of the entrance, and an adjacent land area affording easy and practically unlimited room for city building. The absence of a waterway connection with the interior is noted but not considered a handicap owing to the presence of a direct railway link.

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[12] A good and well illustrated comparison between Danzig and Gdynia is given by Elio Migliorini in "Aspetti geografici e fattori politici nella lotta tra Danzica e Gdynia," *Boll. Reale Soc. Geogr. Italiana*, Ser. 6, Vol. 9, 1932, pp. 3–49. The bibliography includes 86 items.

[13] Ivar Högbom: Polens ekonomisk-geografiska läge, *Geogr. Annaler*, Vol. 12, 1930, pp. 215–253.

[14] A recent statement of the Polish case is presented by Jan Ciechanowski in "The Polish Corridor: Revision or Peace?," *Foreign Affairs*, Vol. 10, 1932, pp. 558–571.

[15] Mimeographed statement issued at the Foreign Office, Warsaw.

The equipment of the port is of the most modern type for the handling of both bulk and package freight. Docks, cranes, warehouses for perishables as well as nonperishables are all so distributed as to provide for the most effective handling of cargoes. The total quayage to be available by 1933 is estimated at about 13,000 meters, and the transshipment capacity at about 15,000,000 tons. When completed, the port will be the largest on the Baltic Sea.

Associated with this rapid construction of the port works has been an equally marked mushroom growth of the town of Gdynia. In 1920 an inconsequential fishing

TABLE II—TOTAL TRAFFIC (EXPORTS AND IMPORTS) (METRIC TONS)

	DANZIG	GDYNIA
1924	2,375,000	10,000
1925	2,723,000	51,000
1926	6,300,000	414,000
1927	7,898,000	898,000
1928	8,616,000	1,966,000
1929	8,560,000	2,823,000
1930	8,213,000	3,626,000
1931 (provisional)	8,330,000	5,335,000

village of a few hundred, it has attained a population of about 38,000 inhabitants. The buildings erected for handling the trade of the port are of modern type,[16] and the entire aspect of the town is in harmony.

GDYNIA VERSUS DANZIG

The progress of Gdynia is viewed with concern by its neighbor. The Free City charges discrimination on the part of Poland and a violation of the sense and spirit of the Treaty of Versailles and the conventions, at the same time claiming the capacity to handle the present trade of both ports and, with improvements, all probable future increases. These charges and the capacity of the port of Danzig are equally denied by the Polish authorities. However, Gdynia enjoys certain advantages.

The dues assessed against traffic are significantly lower at Gdynia because of government subsidies. Superior port facilities are being developed at the Polish port, and the new railway link through the Polish Corridor, circumventing Danzig, gives direct access to Gdynia and will eventually connect directly with Upper Silesia through the line now building. Polish authorities may well believe that the convenience of Gdynia and its newly established rail connections with the hinterland will attract a considerable transit trade for "Czechoslovakia, Hungary, Rumania, the Baltic States, South Russia, and the Near East." An official pronouncement declares that the "large hinterland of Poland gives a guarantee of the fullest employment of the port of Gdynia" while going on to state that this "does not exclude a similar full employment and simultaneous development of the port of Danzig." According to *Commerce Reports* for May 30, 1932, "measures have been introduced such as the establishment at the end of 1931 of import restrictions, contingents, and certain tariff reductions, to assure an increase in the routing via Gdynia of more remunerative exports and imports, at the expense of other Baltic ports, including Danzig, the alternative port within the Polish customs area." Danzig may well look with apprehension on her new rival.

[16] See Harry Gabrielsky: L'importance de Gdynia pour la politique commerciale de la Pologne, *Rev. Écon. internationale*, Oct., 1932, pp. 154–160.

THE SOILS OF AUSTRALIA IN RELATION TO TOPOGRAPHY AND CLIMATE

Griffith Taylor
University of Chicago

IN a recent publication entitled "The Geographer's Aid in Nation-Planning"[1] the writer has described the various factors that control settlement in Australia. These factors are not realized all at once. Total annual rainfall is only a beginning. Seasonal rainfall carries one a stage further. Average drought length is a still more useful way of considering rain control. Rain reliability is a quite separate factor. When all these have been considered, as well as other climatic controls such as temperature and wind, there is still a whole field left unexplored—the factors concerned with topography and soils. I propose to discuss these factors, especially soils, in the present paper.

Topography and Soil Formation

Topographically Australia consists essentially of a Western Peneplain; an Eastern Geosyncline (from the Gulf of Carpentaria to the mouth of the Murray); and the Eastern Highlands, consisting essentially of a number of meridional horst blocks but also including elevated land forms mainly due to gentle folding.

These are shown in a generalized fashion in Figure 1. The areas 1, 2, 3, and 4 consist of the elevated peneplain, which is now about 1100 feet above the sea and consists of Pre-Cambrian and early Paleozoic rocks. It is usually assumed that the elevation occurred in Pleistocene times. Over large areas the surface rocks are buried deep in recent sand dunes—which are now "fixed" by spinifex, by acacias (mulga) and other widely scattered vegetation (14 and 15).

The second major division consists of the Eastern Highlands, mainly built up of Paleozoic rocks, though there are small areas of Triassic rocks west of Sydney and northwest of Brisbane. These highlands constitute a more or less continuous earth wave (or geanticline) festooning the great Western Peneplain. Small areas of rocks of similar age (older Paleozoic chiefly) build up the Flinders Range (north of Adelaide, 5), the Broken Hill Horst (5), and the low Cobar Peneplain (7). The last has been elevated only some 600 feet above the sea but seems to be a small "ripple" between the Flinders Range and the main Eastern Highlands, analogous to the Broken Hill horst.

The Great Geosyncline, although it dates back to Cretaceous times at least, has been a region of deposition throughout much of later geological time. It is numbered 8, 9, 12, and 13. The lowest part today is in the southwest, and naturally the modern rivers flow to this region. In the southern half (12) is the greater part of the Murray Basin, in the northern half (13) is the Lake Eyre Basin. The two are separated by the late Pleistocene or Recent "ripples" of the Flinders Range and Broken Hill. The boundary between 8 and 13 runs northwest from Cobar. It is based on the recent large-scale geological map by Sir Edgeworth David.[2] But in many parts labeled 8 there are deposits of recent alluvial material geologically akin to those of 12 and 13—but not so deep or widespread. The small areas 9, 10, and 11 are hori-

[1] *Scottish Geogr. Mag.*, Vol. 48, 1932, pp. 1–20; and a further article, pp. 65–78.
[2] See review elsewhere in this number of the *Geographical Review*.

zontal deposits of Cretaceous or early Tertiary age, rather distant from 8 but not very different in character.

From the point of view of the formation of a valuable soil covering, two facts stand out. The first is that two-thirds of the Australian continent is a region of late

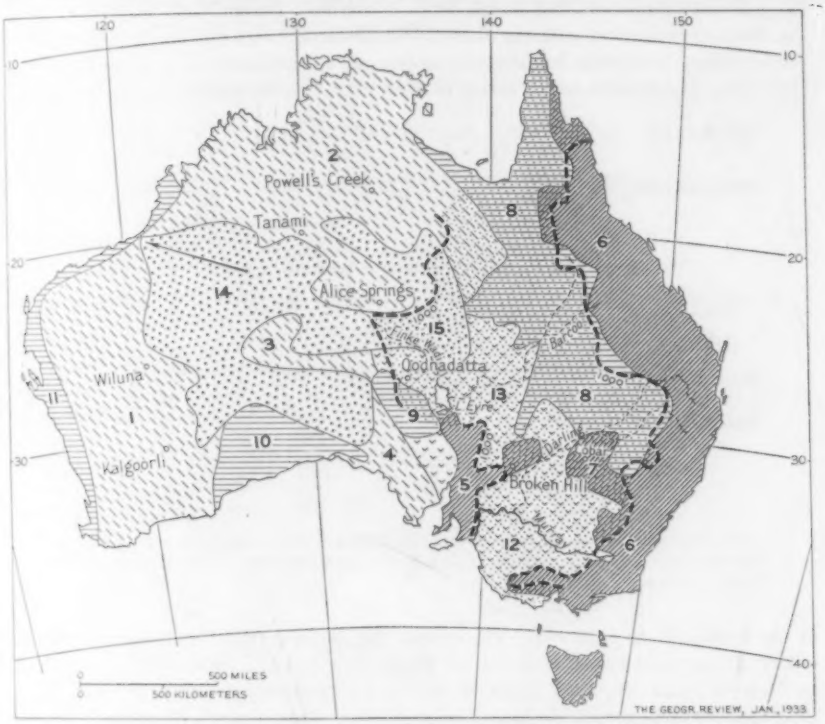

FIG. 1—Structure and soil in Australia. Key: 1, 2, 3, and 4, elevated peneplain of PreCambrian and early Paleozoic rocks; 5, 6, and 7, eastern highlands, mostly tilted Paleozoics forming horsts uplifted in the Pleistocene and including the Flinders Range and Broken Hill horst (5) and the Cobar peneplain (7); 8, horizontal Cretaceous of the great geosyncline; 9, 10, 11, deposits of Cretaceous or early Tertiary age similar to 8; 12 and 13, recent alluvial deposits of the geosyncline; 14 and 15, recent fixed dunes over elevated peneplain. The heavy broken line representing a contour line of 1000 feet marks the approximate boundaries of the main geosyncline. The arrow in the dune area (14) indicates the direction of the dominant southeast trades.

elevation. This includes practically all areas except those marked 8, 12, and 13. It is clear that such elevated areas are not favorably situated for soil deposition but are on the whole likely to be stripped of their covering by the normal action of rain, rivers, etc. Secondly, the region of the geosyncline (8, 13, 12), while its build is more favorable for deposition and contains the deepest soils (Recent alluvials 12 and 13), is almost entirely within the arid portions of the continent. No part of it lies in those eastern areas with a good rainfall, over 30 inches, of fair uniformity throughout the year.

The salient formations as shown in Figure 1 agree fairly closely, though not exactly, with the actual contours. I have added by a heavy broken line the course of the 1000-foot contour. It will be seen that it agrees very closely with the edge of the Cretaceous and Recent deposits on the east. But on the west of the geosyncline the edges of the great Western Peneplain are also below the 1000-foot contour in places.

Soil Classification

Until quite recently no general map of the Australian soils was available. Several isolated workers, such as Guthrie and Jensen, had made studies of separate areas, and the latter had published a book on the "Soils of New South Wales"[3] in 1914. He used such classes as Red Basalt Soils, Black Soil Plains, Cold Tableland Soils; but he compared them with the Russian nomenclature in a number of instances.[4] A more modern treatment has recently appeared, by Professor J. A. Prescott[5] of the University of Adelaide, which seems to me a very notable addition to our knowledge

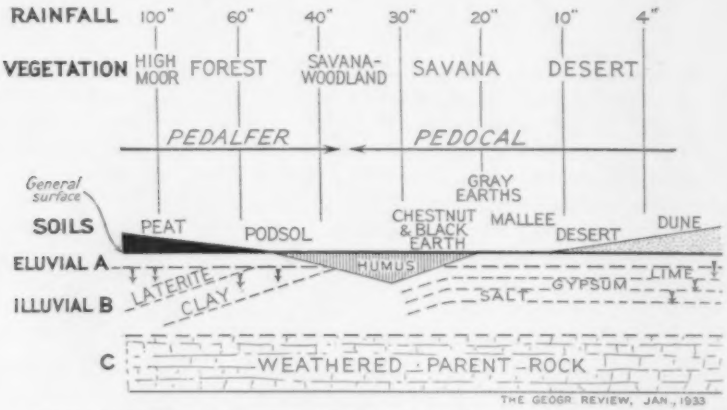

FIG. 2—A generalized diagram showing the relation of Australian soil groups to rainfall. The characters of the three major profiles, A, B, C, are indicated. (After Neustruev and Prescott with slight modification.)

of the resources of Australia. He follows the Russian view that the soil type is essentially a product of climate and not of parent material. More recently, however, as Prescott notes, the latter factor is receiving greater recognition in Russia.

Prescott classifies his soils in general as follows: Peat, Podsol, Black earth, Chestnut (or Red-Brown) earth, Gray earth, Mallee soils, Desert-steppe soils, and Dunes. They follow in a series from those with heavy rainfall to those with very low rainfall. This is shown diagrammatically in Figure 2. In accordance with the Russian convention now generally recognized the soil horizons A, B, and C are indicated. A, the eluvial horizon, is leached heavily in rainy areas, and the iron and clay products are redeposited in the B, or illuvial, horizon. In desert areas lime, gypsum, and salt are redeposited in the illuvial layer. Below is the weathered portion, C, of the parent rock. Humus develops *in* the soil extensively under intermediate rain conditions. Peat grows *on* the surface in very wet areas. Sand piles up *on* the surface in very dry regions. Soils rich in iron and clay have been designated Pedalfers by Marbut; those rich in lime, Pedocals. The appropriate vegetation zones are given at the top of the diagram.

Soils and Climate

To the geographer the chief interest perhaps lies in the relation of soil and climate. A second aspect of the problem of special interest in Australia deals with the bearing of the new soil data upon the widespread dunes and laterites. Let us now compare

[3] H. I. Jensen: Soils of New South Wales, Sydney, 1914.

[4] For a summary of Jensen's conclusion see Griffith Taylor: Agricultural Regions of Australia. Part II, *Econ. Geogr.*, Vol. 6, 1930, pp. 213–242; especially pp. 213–214.

[5] The Soils of Australia in Relation to Vegetation and Climate, *Commonwealth of Australia Council for Sci. and Indust. Research Bull. No. 52*, Melbourne, 1931.

the soil map, Figure 3, simplified from Prescott's map, with the combined topographic and geological map of Figure 1. Little correspondence appears. The outer soil zones lie in narrow belts around a vast oval area of desert-steppe soils. There is nothing on the soil map that indicates the presence of either peneplain or geosyncline. For instance, the podsols run right round the coast from the northwest along the north and down the east coast to Melbourne.

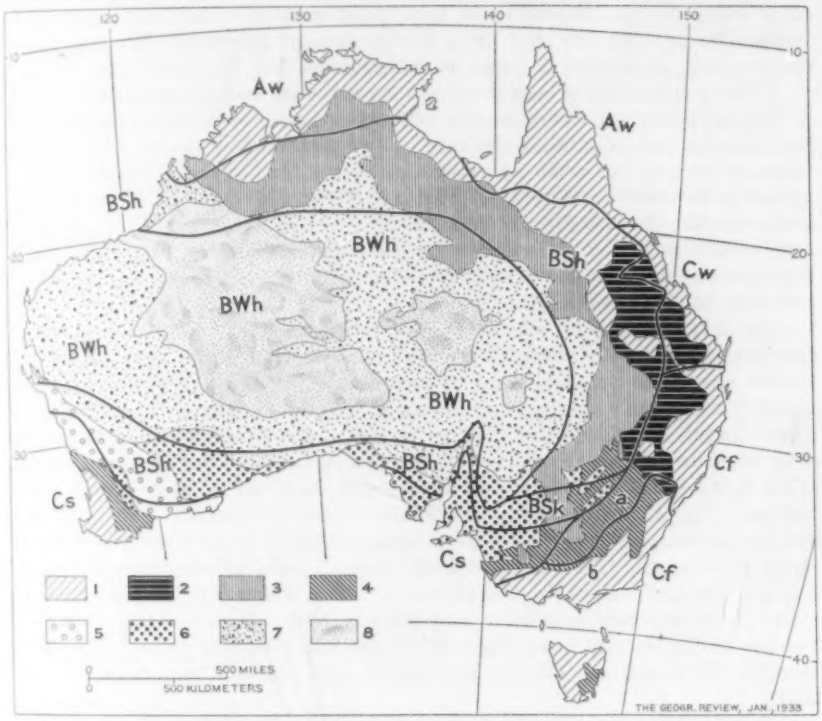

FIG. 3—The major soil divisions of Australia, after Prescott. Key: 1, podsol; 2, black earth; 3, gray earth; 4, chestnut earth; 5, very lateritic; 6, mallee; 7, desert-steppe; 8, dune. Laterites are widespread north of 20° S. latitude.

Climatic regions, after Köppen (see review of Griffith Taylor: Climatology of Australia, in this number of the *Geographical Review*), are added for comparison.

The soil boundaries clearly agree moderately well with the annual isohyets. For instance, Prescott's podsol area is found almost universally where the rainfall is over 30 inches a year—whether the rain falls in summer, as in the north, or in winter, as in the south, or fairly uniformly, as in the eastern littoral.

It is of interest to compare the soils map with Köppen's classification of climates, so widely used as a basis of geographical discussion. Köppen's boundaries have been placed on Figure 3. It is seen that the podsols fall in his divisions Aw, Cw, and much of Cf and Cs. Hence the soil does not seem to vary very closely with Köppen's divisions. If it did we should surely expect soils with Aw climates to be distinctly different from those with Cs climates.

Between the podsols and the desert-steppe soils is a series of interesting soil types. In the north and northeast are the gray earths and the black earths. In the south are the chestnut earths, mallee soils, and laterites. The gray earths occur in regions with about 15 to 30 inches in the north and 15 to 20 inches in the east.

They agree approximately with Köppen's BSh. The black earths are perhaps the most interesting of all, since they are so fertile that they offer unrivaled facilities for prolonged agriculture. In Australia they occupy the moderately elevated country in the central part of the Eastern Highlands. Here an unusual number of Tertiary volcanoes have enriched the soil with basalt products.[6] It is, however, difficult to see any adequate reason why this soil area should differ from those immediately north or south. There is no striking climatic difference. However, the Black earths occur where the total rainfall varies from about 20 to 30 inches annually, is fairly uniform through the year, but has a definite summer maximum. This soil type is fairly equally distributed in Köppen's three regions BSh, Cw, and Cf.

In the southern belt of soils the chestnut earths may be first considered. These, as Prescott points out, clearly form a southern extension of the black earths, where the rainfall is mainly of the winter type. They agree fairly well with Köppen's Cfa region in the east, but in the west they form part of the Csa area. The mallee soils appear to be unknown elsewhere. They are due to the combined action of a low winter rainfall, the prevalence of sand hills, and the carriage inland of sea salt (cyclic salt) by onshore winds. They usually contain much lime—which may produce sheet limestone surfaces if the parent rock is essentially calcareous. They agree moderately well with Köppen's Bsh region.

The abundant lateritic soils in Australia have been discussed in many papers: they are referred to in Prescott's bulletin. Early investigators assumed that the laterite was due to the evaporation of underground waters rising from below under capillary forces and evaporating at the surface in an arid or semiarid climate. But recent workers have found that the lateritic soils are particularly acid, and this with other evidence suggests their formation during a period much wetter than at present exists in Australia. In effect, the characteristic cappings of laterite are fossil B horizons (Fig. 2), formed under conditions of greater rainfall. The hypothesis assumes the denudation of the original A horizons (Fig. 2) which would be essentially sandy in character. "This denuded sandy material probably contributes in a major degree to the sand hills of the desert interior." This interesting theory seems to the writer to be extremely suggestive, and gives us fresh evidence of the remarkable changes in climate that have characterized the last geological epoch in Australia. Possibly the widespread siliceous cappings in arid Australia may have a similar origin.

The area of the sand dunes in the west is much the same in both Figures 1 and 3. It is, indeed, significant of a wholesome change of opinion when an authoritative government department labels so much of Australia as desert-steppe or sand dunes. The present writer believes that the smaller eastern dune area, in Figure 3, should be extended greatly to the north and northwest, as shown at 15 in Figure 1. But this perhaps is a matter of how we define steppe and dune. It is to be noted that there is no climatic difference, so far as the writer has been able to determine, between the dune country and the steppe country.[7] The climatic isopleths run east-west and supply no clue to the rather definite north-south boundaries of the true sand-dune desert.

Soils of Australia and the United States

We shall conclude with a rapid comparison of climate-soil relations in Australia and the United States. In so far as they are comparable, soil divisions for the United States are taken from Wolfanger's map in his book "The Major Soil Divisions of

[6] See Figure 2 in Griffith Taylor: The Topography of Australia, *Official Year Book of the Commonwealth of Australia No. 20*, Melbourne, 1927, pp. 75–88.

[7] See Griffith Taylor: Limits of the Australian Desert, *Gerlands Beiträge zur Geophysik*, Vol. 33, 1931, pp. 16–30.

the United States."[8] Tabulating according to climatic regions we derive the following:

Soil Division	Climatic Regions (Köppen)	
	Australia	U. S. A.
Podsol	Aw, Cw, Cf, Cs	Mainly Dfb
Black earth	BSh, Cw, Cf	BS, BSk
Gray earth (arid)	BSh	BSk, BW
Chestnut earth	CFa	Dfb, BSk
Laterites	BSh (SW Australia)	Cfa (Florida)

This tentative table does not suggest any very close dependence of soils on climate. Only in one or two cases is there any agreement between the climatic régimes in the two continents. Of course the similarly named soils of Prescott and Wolfanger may not really be sufficiently alike for application of Köppen's classification, or the classification may not be everywhere applicable to soils. However, it serves to illustrate the problems included in this new and important work on the borders of geography, geology, and agriculture, to which Professor Prescott's stimulating paper is a welcome contribution.

[8] L. A. Wolfanger: The Major Soil Divisions of the United States, New York, 1930.

DEVELOPMENT OF DRAINAGE SYSTEMS AND THE DYNAMIC CYCLE

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Columbia University

IN recent papers Waldo S. Glock[1] has advanced the suggestion that physiography, or physical geography, should be regarded as dual in nature, having a static or passive phase called geomorphology and a dynamic or active phase which he would name geodynamics. I have elsewhere[2] discussed the question as to whether geomorphology, which treats the active evolution of ever-changing land surfaces in terms of "structure, *process*, and *stage*," can properly be regarded as static or passive.

In the pages that follow it is desired to focus attention on another aspect of Glock's thought-provoking suggestion. He states that "physiography may be approached from a purely dynamic viewpoint" and proposes a "dynamic cycle" distinct from the geographic or geomorphic cycle. As concrete illustrations of the dynamic point of view he gives us a shorter and a longer discussion of the development of drainage systems in which successive phases of "extension" and "integration" of stream lines are illustrated by reproductions from selected topographic maps. The dynamic point of view is consistently adhered to in these illustrations, which show only streams of water and some of the associated marshes but no valleys. This gives the reader an opportunity to judge how effective may be the more restricted method of treatment.

The thesis supported in the present discussion is that even when one adopts the purely dynamic viewpoint, as Glock purposely does in his papers on the development of drainage systems, one cannot afford to leave *form* out of consideration, even temporarily. Just as no geomorphologist can accomplish his work without drawing heavily on dynamic geology, so the dynamic geologist finds in the study of land forms an invaluable aid to research. He may properly have a purely dynamic *viewpoint* in his investigation; but, if he takes only a dynamic *view*, he has an incomplete and hence an erroneous conception of his problem.

Stream Lines and Valley Forms

To the study of drainage problems the forms of the land bring precious aid. Few streams have existence independently of the forms that encompass them. Especially where studies are based on maps must the forms be taken into account, if for no other reason than that countless streams are represented on maps *only by the forms of the valleys they have carved*. To trace from a topographic quadrangle merely the blue lines representing streams large enough to justify representation on a map of given scale and degree of accuracy, is to take account of but a fraction of the streams actually present in the region. That is why it seems to the writer that the maps of stream lines reproduced in Glock's papers form an insufficient

[1] Waldo S. Glock: The Development of Drainage Systems: A Synoptic View, *Geogr. Rev.*, Vol. 21, 1931, pp. 475–482; *idem:* The Development of Drainage Systems and the Dynamic Cycle, *Ohio Journ. of Sci.*, Vol. 31, 1931, pp. 309–334; *idem:* Dual Nature of Physiography, *Science*, Vol. 72 (N.S.), 1930, pp. 3–5.

[2] Douglas Johnson: Physiography and the Dynamic Cycle, *Science*, Vol. 75 (N.S.), 1932, pp. 636–638.

basis for his discussion. Practical considerations may render reproductions of form lines (contours) costly or difficult; in such case the text discussion may take adequate account of significant forms that cannot well be reproduced. But to leave form largely or wholly out of consideration in order to get a more strictly dynamic view of drainage problems is to suffer deprivation of highly essential data.

In studying degrees of stream extension, their headward growth (elongation) into new territory, and the constant addition (elaboration) of smaller and smaller tributaries, one has to deal largely with minor valleys containing no permanent streams. In map studies of such phenomena, one must take into consideration countless stream lines revealed only through valley forms as represented by contour lines, if correct conclusions are to be reached. On the Degonia Springs (Ind.) quadrangle, for example, the reproduction of the blue stream lines alone gives the impression that there has been a general loss of complexity and "integration" of the drainage, as Glock calls it, throughout the whole area, as compared with the Crawford (W. Va.) quadrangle.[3] This is true regarding areas bordering the main streams, which have widened their valley floors. But the remainder of the map, as revealed by the contours, shows a greater complexity, a more marked elaboration of the drainage than is represented in the Crawford area. That extension is not yet complete in the Degonia Springs area is suggested by the apparent presence of upland strips followed by certain roads, although the contouring is not sufficiently accurate to enable one to speak with assurance on this point.

Something of the same difficulty arises in comparing reproductions of blue stream lines from the Degonia Springs (Ind.) and the Princeton (Ind.–Ill.) quadrangles. This restricted comparison seems to show an enormous advance in "integration" in the latter area as compared with the former. But when the contoured areas are compared, the outstanding difference between the two maps is the presence on the Princeton quadrangle of two large rivers with associated wide, flat, and artificially drained flood plains. It may be questioned whether the areas immediately adjacent to these large rivers ever went through the stage of drainage development represented on the Degonia Springs quadrangle. Lateral corrasion by the large streams may have consumed much of the immediately adjacent upland before it had a chance to be maturely dissected. Certainly the small streams on the Degonia Springs quadrangle may reduce that area to a peneplane without ever giving a topography quite like that shown on the northwestern half of the Princeton quadrangle. The drainage areas of small headwater streams are not quite comparable with the lower courses of large rivers, since the conquest of adjacent territory in the two cases may in large part be accomplished by different processes.

Stream Extension and Texture of Topography

When a series of drainage maps are arranged in the order of stream complexity shown on them, progressively increasing ramification of minor tributaries in successive maps of the series does not necessarily represent successive stages in a normal sequence of "extension," as Glock uses the term. The *texture* of the drainage pattern is, of course, affected by stage of development; but it is also affected by various other things, including climate and character of rock. The coarse texture of one area, with few widely spaced streams, does not necessarily represent an earlier stage of dissection than the fine texture of another. Both may represent the maximum degree of stream extension and complete conquest of their respective areas. The widely spaced streams will never branch farther than they do, because humid climate and resistant rocks compel a coarse texture at every stage of dissection. On the other hand, the fine-textured area may never have possessed widely spaced drainage lines

[3] These and other maps mentioned throughout the text are used as types by Glock, and the discussion is based on his treatment of them.

in the past and may reach old age without losing a sufficient number of stream lines to give as wide spacing as that possessed in maturity by the coarse-textured area.

Limitations of Map Interpretation

Texture as it appears on a given map, whether shown by stream lines alone or by both stream lines and form lines, is affected in no small degree by the accuracy

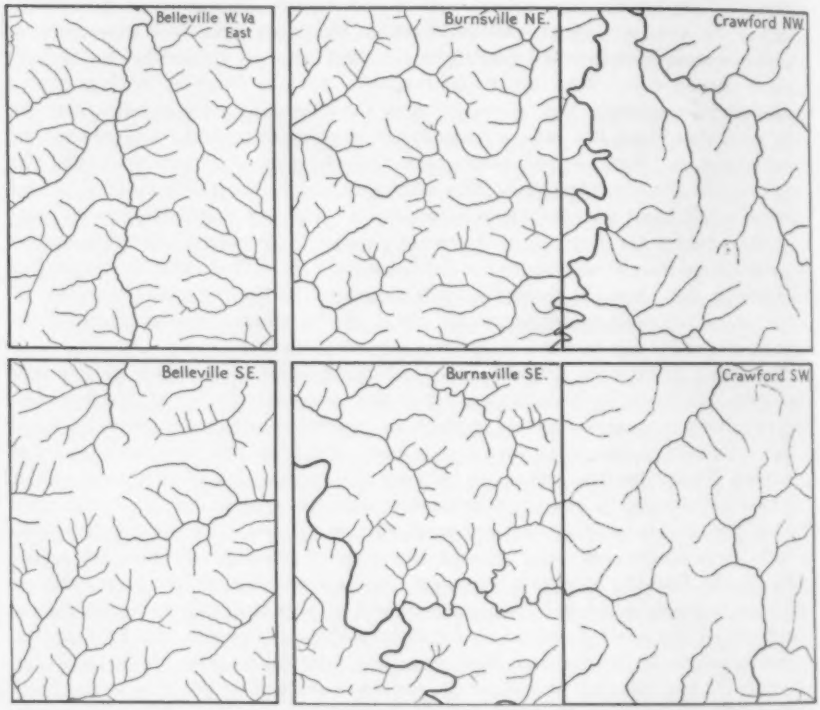


FIG. 1—The two left-hand rectangles (from the Belleville, W. Va., quadrangle) represent a distinctly finer texture, a more minute ramification of drainage lines, than the two right-hand rectangles (Crawford, W. Va.). The central rectangles (Burnsville, W. Va.) are similar to the Belleville rectangles at the left. But since they directly join the Crawford rectangles and the change in drainage pattern coincides with the artificial boundary between two adjacent quadrangles, the drainage differences are more apparent than real and presumably result from less complete mapping of streams in the Crawford area.

of the mapping. One map may appear to show a greater elaboration of the drainage pattern than another and thus to represent a more advanced stage in what Glock has called the "dynamic cycle," when examination of the two areas would reveal actual conditions just the reverse of those indicated by the maps. This is because one topographer has placed on his map a larger proportion of minor drainage lines than has the other, perhaps because of greater skill, or because of more rigid requirements in later than in earlier topographic work, or because of fewer natural obstacles such as heavy forests, or because of larger available funds permitting more detailed surveying. This is one of the limitations of map interpretation from which the student cannot escape. But the reader must appreciate that the limitation exists and must make due allowance for the significant errors it may introduce into comparisons of drainage patterns.

Often one can form a judgment as to the accuracy of a given topographic map

either from the internal evidence of the map itself or from comparison with immediately adjacent areas surveyed under different conditions. Some of the maps employed in Glock's series are from fairly old surveys, and the well rounded, expressionless contours indicate less accurate and less detailed mapping than that shown on quadrangles of more recent date.

Significance of Texture in the Crawford (W. Va.) Area

In other cases not the date of surveying but other factors have obviously affected relative accuracy. The Crawford (W. Va.) quadrangle shows less elaborate drainage than the Belleville (W. Va.) quadrangle and is interpreted by Glock as representing a more advanced stage in his "dynamic cycle." The former supposedly greater elaboration in the Crawford area is believed to have been lost through "integration" of the minor drainage lines. The Crawford quadrangle was surveyed more recently than the Belleville, but for it a contour interval of 50 feet was employed as compared with 20 feet in the Belleville area. There is evidence that with this larger contour interval less accuracy was achieved in the Crawford area. Fortunately, just north and just west of the Crawford quadrangle are quadrangles mapped on the 20-foot interval; when these are placed in contact with the Crawford sheet, the contrast is striking. The Weston quadrangle to the north and the Burnsville to the west closely resemble the Belleville but appear quite unlike the Crawford. As the change takes place sharply along the artificial limits of the Crawford quadrangle it is clear that the apparent contrast is primarily a matter of cartography (Fig. 1).

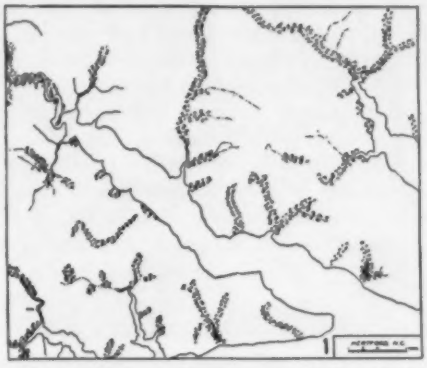


Fig. 2—Drainage features on a portion of the Hertford, N. C., quadrangle, after Glock. Compare with Figure 3.

If the reader wishes a striking object lesson in the tremendous importance of cartographic accuracy as a factor in map interpretation, let him place side by side the 1885 survey and the 1900 survey of the Burnet (Tex.) quadrangle. These two maps show identical areas mapped on the same scale, the older employing a 50-foot, the later a 25-foot contour interval. It would be difficult to imagine two areas more utterly unlike as to topographic form and degree of drainage ramification. Yet the two maps supposedly represent the same topography and the same drainage lines. The remarkable contrast is wholly cartographic in origin.

There are real differences between the Belleville area, on the one hand, and the Crawford-Weston-Burnsville area on the other. The former is a low plateau, from 900 to 1100 feet in elevation, maturely dissected near a large river, the Ohio. The Crawford area is a much higher plateau, 1500 to 2300 feet, maturely dissected but in general farther removed from a smaller main river, the Little Kanawha. These and other differences, including differences in rock resistance, have influenced dissection, and there appears to be, on the whole, a somewhat finer texture in the Belleville plateau. But, as has been already seen, texture is not a safe indication of stage in extension or integration of drainage lines. If one may judge from the character of the adjacent Burnsville quadrangle, the Crawford area would, if mapped with the same precision, show an earlier instead of a later stage in the "dynamic cycle" when compared with the Belleville area.

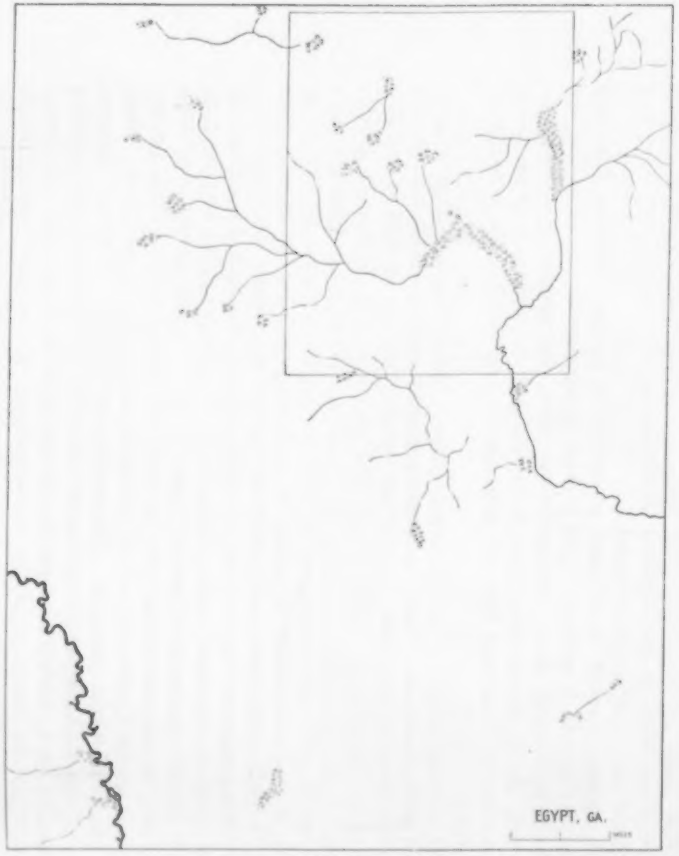


FIG. 3

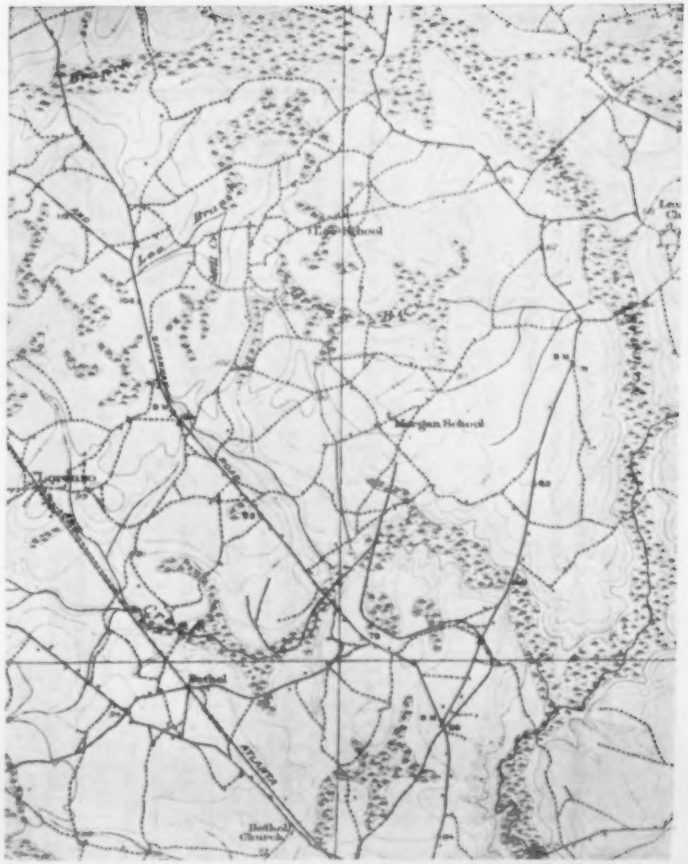


FIG. 4

FIG. 3—Reproduction of streams and marshes of the Egypt quadrangle, Georgia, after Glock. The small rectangle represents the area shown in *Figure 4*.
FIG. 4—Photographic reproduction on a reduced scale of a portion of the Egypt quadrangle, Georgia (see small rectangle in Figure 3). The contours (10-foot interval) are faintly seen.

Further Limitations of Map Interpretation

The limitations as well as the possibilities of map interpretation must be kept clearly in mind throughout comparison of the drainage maps arranged in sequence by Glock. Parallel linear streams of relatively great length may represent extension by headwater elongation; but they may also represent consequent streams descending initial parallel depressions and having experienced little or no headwater growth. Stream capture cannot safely be inferred (especially in the irregular, dendritic pattern of plains and plateaus) where headwater branches of one stream seem to turn abruptly from a direction that would lead them to another drainage basin. Where migrations of divides are in progress, it cannot be assumed that some streams acquire territory by a "permissive behavior," others by "aggressive behavior"; for every stream always "extends into territory rightfully belonging to it in the course of natural development, that territory which it would be expected to occupy because of its position and relations"—if only maps or field studies could reveal to us the true position and relations of the stream so that we might expect the right thing! Marshes cannot be accepted as precursors of an expanding drainage system, since they are, under certain conditions, characteristic of fully established mature and old valleys. Small streams that appear to end without reaching the sea and without joining a main stream so far as the map shows, must not be interpreted as indicating the initiation of drainage systems; for there are many causes that compel streams to behave in this manner late in their histories.

Comparison of the Hertford (N. C.) and Egypt (Ga.) Areas

As an example not only of the difficulties inherent in map studies, but also of the valuable inferences deducible from such studies, let us consider the two maps that Glock puts first in his series as illustrating the very beginning of his dynamic cycle, "the initiation of a drainage system." The maps are a part of the Hertford (N. C.) quadrangle and the Egypt (Ga.) quadrangle of the U. S. Topographic Atlas (Figs. 2 and 3). Of these two Glock places the Hertford sheet first and apparently considers it slightly earlier in the drainage history than the other. Streams and swamps alone are represented, except that the shore line of Albemarle Sound also appears on the Hertford quadrangle. Some swamps do not connect with the sea or with the nearest rivers, and some streams are represented as terminating in swamps or in open, dry country.

Glock labels his reproduction of the Hertford drainage "the initiation of drainage systems; almost pre-extension for the most part"; and writes[4] that it "indicates what may be expected at the start of extension when drainage begins to be concentrated along definite paths. A number of the streams end without uniting into, or joining, a main, and swamps in some cases conveniently mark the courses of future streams." The Egypt area is in one paper labeled: "The initiation of a drainage system. The first attempts at the formation of definite drainage courses, hence the very beginning of extension"; while in the other paper it bears the title: "The start of dendritic extension. Swamps occur on uplands and lowlands." Of this area Glock writes in the earlier paper[5]: "The initial phase of extension as illustrated by Figure 1 (reproduced as Figure 3 in the present discussion) is characterized by a notable lack of streams over a large percentage of surface, by the indefinite termination of many streams without combining into a main stream," etc. In the later paper[6] he says of the same area: "The streams on Figure 2 (Figure 3 of the present discussion) show a better degree of organization than those on Figure 1 (Figure 2 of this paper); they also show the disappearance in large measure of the indecision and hesi-

[4] Glock, The Development of Drainage Systems and the Dynamic Cycle, p. 311.
[5] Glock, The Development of Drainage Systems: A Synoptic View, p. 478.
[6] Glock, The Development of Drainage Systems and the Dynamic Cycle, p. 311.

FIG. 4

FIG. 3.—Reproduction of streams and marshes of the Egypt quadrangle, Georgia, after Glock. The small rectangle represents the area shown in Figure 4.
FIG. 4.—Photographic reproduction on a reduced scale of a portion of the Egypt quadrangle, Georgia (one small rectangle in Figure 3). The contours (20 feet interval) are faintly seen.

tancy of preëxtension. Essential features of the future system have become apparent, although a few streams still end indefinitely."

If the reader will compare the contoured quadrangles from which Glock traced stream lines and swamps, he may note first of all that the Hertford area was surveyed from 14 to 16 years earlier than the Egypt area and that the earlier sheet shows evidence of having been mapped with less precision. He may next note that the Hertford area lies so low (all of it below 20 feet) that only one contour line appears on the whole map, the 10-foot contour. Knowledge of the surface form of this area is thus restricted, although we shall see that this one contour, the shore line, and the marshes provide precious data which must affect our conclusions. The Egypt area is not only more recently and more accurately mapped, but, as it rises more than 140 feet above sea level at one point and has uplands from 30 to 50 feet above adjacent valley bottoms, much more information concerning the form of its surface is available. At the outset the possibility must be recognized that a better map of the Hertford area might compel one to assign that region a much later place in the history of drainage development than is represented by the Egypt quadrangle.

Interpretation of the Egypt Topography

The more abundant information on the Egypt quadrangle, particularly in regard to land forms, will aid one in interpreting the less clearly defined history of the Hertford area. The distribution of marshes or swamps in relation to land forms is highly significant. Glock's tracings of drainage from the Egypt quadrangle reproduce only a few marshes, especially those through which no definite stream channels were represented by the topographer. The few marshes thus reproduced are so generalized in his drawing that they fail to show the very perfect dendritic drainage pattern assumed by certain of them, as for example that at the head of Mill Creek in the north-central part of the district (Fig. 4, northwest of the center of the map).

On the other hand, the quadrangle itself shows that the main streams are usually bordered by continuous belts of marsh and not by limited areas interrupting the continuity of drainage channels; that these bands of marsh, instead of being irregular patches on an undrained upland, occupy the flat floors of mature valleys cut anywhere from less than 20 to more than 50 feet below the upland surface; that contours clearly define the valley walls and delineate a continuously downward sloping valley floor even where the descending waters flow through the marsh by courses which the topographer could not, or at least did not, define; that both contours and branching belts of valley-bottom marsh show the existence of tributary branch valleys of normal dendritic pattern; that some of the dendritically branching marshes are due to artificial blocking of minor valley systems by railroad and road embankments; and that the apparent discontinuity of drainage on this map is in part due to such artificial barriers across valleys and in part to the difficulty or impossibility of locating definite stream channels through parts of the valley floor swamps.

It is not possible to say that none of the many marshes represented on the Egypt quadrangle do not occupy undrained natural depressions. The rectilinear marshes in the southeastern part of the sheet, referred to by Glock, occupy swales between ancient beach ridges and appear to be undrained. But this much is made clear by a study of the surface forms of the Egypt quadrangle: Every one of the drainage lines shown on Glock's drawing as terminating indefinitely without combining into a main stream is really an integral part of a definitely established drainage system, developed so long ago that it has cut a continuous valley floor some distance below the upland surface. The swamps, which in appearance terminate or interrupt these drainage lines, do not mark the courses of future streams but the valley floors of streams already far advanced in their cycle of development.

Interpretation of the Hertford Topography

If now we turn to the Hertford quadrangle, we note first of all that the region is bordered by a shore line of submergence and that the breadth of the drowned valleys implies a considerable advance in stream history before the submergence occurred. This seems incompatible with the idea that we have here the initiation of drainage systems. Examination of the marshes shows that many of them have a dendritic branching pattern; and since there is no known way in which marshes can gain the dendritic pattern in advance of the development of dendritic valleys, we are led to infer that these marshes really occupy the floors of valleys previously carved.

This conclusion is confirmed when we examine the 10-foot contour, the only one on the Hertford quadrangle. In so many cases does this contour outline the margins of dendritic depressions occupied by marshes and streams that one feels reasonably sure 2-foot contours would reveal the fact that nearly all, if not all, of the marshes shown in the area are of the valley bottom type and hence mark the courses of past and present rather than future drainage.

As regards the interrupted drainage of the Hertford area, the rather systematic association of many of the interruptions with road crossings leads to the suspicion that road embankments have here, as on the Egypt quadrangle, artificially interrupted formerly continuous belts of valley bottom marsh. This suspicion finds confirmation where the 10-foot contour shows that a valley depression is continuous right across the dry land bordering the road and, again, where the same contour appears to follow an embankment out across a marshy valley floor. In a few cases valley bottom marshes fail to continue to the shore line of Albemarle Sound; but this fact finds reasonable explanation in the well known process of blocking minor valley mouths with sand transported by shore currents.

The topography shown on the Hertford quadrangle is not sufficiently accurate to justify definitive conclusions. But one completes examination of the quadrangle with the strong conviction that drainage in this area of exceptionally low relief was long ago established and that the interruptions attributed to initiation of streams are of later origin and are due to artificial and natural causes unrelated to the normal development of drainage. Valley forms, even when so poorly indicated as here, afford data highly important for anyone investigating the dynamics of drainage development.

Conclusion

We conclude our discussion by quoting again the conviction expressed as a thesis in the introduction: Even when one adopts the purely dynamic viewpoint, one cannot afford to leave *form* out of consideration. Just as no geomorphologist can accomplish his work without drawing heavily on dynamic geology, so the dynamic geologist finds in the study of land forms an invaluable aid to research. In map studies, especially, data regarding the dynamics of stream action and other forces are liable to prove incomplete and misleading unless full use is made of all information the maps furnish regarding surface forms.

THE DEVELOPMENT OF POLISH CARTOGRAPHY SINCE THE WORLD WAR

W. L. G. Joerg

TO the rôle that maps play in emphasizing national consciousness anyone may bear witness who calls to mind how much more intimate is his knowledge of his own country than of foreign countries, even those immediately adjoining his own. Apart from the greater familiarity inevitably brought about by residence, domestic travel, and early acquaintance with national literature and history, this disparity is in no small measure due to the more detailed treatment accorded his own country in the geographies he used at school and in the general reference atlases he may have been using since. In the post-war era it is naturally the citizens of the newly created states in Europe who have been most in need of this unifying portrayal, and none more so than those of Poland, whose reconstituted territory had been for over a century under the jurisdiction of three powers of widely divergent culture and administrative systems. To provide such a picture in the field of geography, and especially graphically by means of cartography, is the task to which no one has addressed himself with more conspicuous success than Professor Eugene Romer of the University of Lwów.

Professor Romer's Work

Specializing even before the World War in the geography of the former territory of Poland, Professor Romer brought these studies to a focus in the "Atlas de la Pologne: Géographie et Statistique,"[1] which, published in 1916, made the scattered and disparate material concerning Poland available to the commissions of inquiry preparatory to the peace conference. A second edition appeared in 1921. A related but less comprehensive atlas is his "Atlas des Problèmes Territoriaux de la Pologne," Lwów, 1921, reproducing some of the maps prepared by the Polish delegation to that conference.

With the new state entering upon its independent existence Professor Romer turned to the educational field as the most promising. Establishing under the name of Książnica-Atlas a cartographic institute in Lwów by the consolidation of an existing map-engraving plant with a publishing concern, he launched upon the publication of a great series of school wall maps and atlases. In the ten years or so that have elapsed since the founding of the institute more than thirty wall maps and many atlases have appeared, which, taken together, satisfy the geography-teaching needs of the Polish educational system from the secondary schools to the university. In this work he has had the collaboration of T. Szumański, S. Pawłowski, J. Wąsowicz, and others. Among the distinctive maps in the wall series, maps that represent original compilations of interest outside of Poland also, may be mentioned: a set of Poland as a whole on the scale of 1 : 850,000 showing physical conditions, political divisions, ethnography, and industries and a set of physical maps of the different sections of the country on scales of 1 : 200,000 and 1 : 300,000. Less distinctive, but of national importance because emancipating Polish schools from foreign map importations, is a series of physical wall maps of the continents and of individual countries of Europe.

[1] Reviewed in *Geogr. Rev.*, Vol. 11, 1921, pp. 308–309.

The school atlases, which have appeared in many editions differing considerably the one from the other, consist, apart from a recent historical atlas ("Szkolny Atlas Historyczny," by W. Semkowicz and C. Nanke), mainly of four types, a small elementary atlas ("[Mały] Atlas Geograficzny"), an atlas of Poland as a whole ("Atlas Polski Współczesnej"), a series of sectional atlases of the different voivodeships or groups of voivodeships of Poland ("Atlasy Krajoznawcze"), and an advanced comprehensive atlas ("Powszechny Atlas Geograficzny"). The small atlas, first published in 1908 and received with much approbation when presented by its author to the International Geographical Congress at Geneva in that year, consists mainly of hypsometric maps of the continents. These maps, at that time engraved and printed by the Military Geographical Institute of Vienna, with their detailed and delicate contours, their relatively close contour interval for general maps, and the perfect register of their altitude tints, strike the keynote of all the author's future cartographic work. So fundamental compilations were these continental maps that they have been used again and again in the author's atlases down to the present day with almost no changes except for variations in the color scheme.[2] Special value attaches to the atlas of Poland as a whole and the sectional atlases for the same reason as in the case of the two corresponding wall map series, of which they are to a certain extent a counterpart. In both atlas types hypsometric maps form the nucleus, general ones of Poland on the scales of 1 : 5,000,000 and 1 : 2,500,000 (and of western Russia in 1 : 3,750,000), sectional ones in 1 : 1,000,000. The atlas of Poland further contains geologic, climatic, phytogeographic, zoögeographic, and economic maps; and the sectional atlases, plans of the chief city and large-scale maps of areas of special interest in the voivodeship in question.

Representation of Relief

In all the maps published by the Książnica-Atlas cartographic institute relief is exclusively represented by means of contours and altitude tints, of which method Professor Romer is a confirmed advocate.[3] Although it may be argued that the ideal method of representing relief on general maps is by a combination of hachuring or shading to represent relative slope and altitude tints to represent absolute elevation,[4] to apply that method successfully requires a highly specialized drafting and engraving technique that has been developed in only a few countries.[5] Where no craftsmen trained in that tradition are available it seems an eminently wise decision to employ the altitude-tint method, especially when, as in the maps under discussion and in the well known "Survey Atlases" of England and Scotland by J. G. Bartholomew of the Edinburgh Geographical Institute, the contour interval is made small. Owing to this small interval the effect produced in the maps of the Romer institute is one of plasticity of relief, especially in the editions published within the last two or three years; in these a particularly felicitous choice of greens for the lowland tints and the introduction of offset printing have given better although properly subdued expression to the relatively level terrain of the greater part of Poland. Especially is this true of the 1 : 1,000,000 sectional maps referred to above, which, owing to these

[2] See "The Tenth Edition of the Maly Atlas Geograficzny: Report of the Editor," *Polish Cartogr. Rev.*, Vol. 3, 1928, pp. 161–173.

[3] See his "Hachure in Recent Cartography," *Rept. of Proc. of Internatl. Geogr. Congr. at Cambridge 1928*, Cambridge, 1930, pp. 149–152, and fuller in Polish in *Polish Cartogr. Rev.*, Vol. 3, 1927–1928, pp. 174–183.

[4] W. L. G. Joerg: Post-War Atlases: A Review, *Geogr. Rev.*, Vol. 13, 1923, pp. 583–598; reference on pp. 584–585.

[5] On the merits of the two methods see the discussion of Romer's paper at the Cambridge Congress, *op. cit.*, p. 152, and the discussion of W. L. G. Joerg: La représentation généralisée du relief des États Unis, in forthcoming proceedings of the International Geographical Congress at Paris, 1931; also L. Visintin: Appunti di critica cartografica, *La Geografia*, Vol. 14, 1926, pp. 42–60, especially pp. 56–59.

circumstances and to the larger number of tints within the same altitude range, may almost be said to be superior to the sheets (see below) of the International Map of the World for the corresponding areas. It is a case in point of a restricted region that, taken by itself, may be represented more adequately by symbolism unfeasible for use on the International Map, the underlying principle of which is uniform treatment in order to permit of world-wide comparisons.

The need for a small contour interval, and hence a large number of tints to give adequate representation to relief if the hypsometric method is used, led to experimentation in the institute to find a means of lessening the cost of printing by reducing the number of color plates necessary to produce a given effect. Mr. Witold Romer, the son of Professor Romer, finally worked out a process, which has been patented under the name of "Cartochromy," whereby a larger number than heretofore of ruled patterns are produced on a single plate by means of what may be termed accretional photographic exposure and whereby in addition it is possible to print line elements from the same plate as areal tints of the same color.[6] By this process have been printed the eleventh edition (1931) of the small elementary atlas, on the 1 : 5,000,000 map of Poland in which nine hypsometric and bathymetric tints as well as the railroads and the flat lake colors have been produced from three plates, and a striking tourist map of the Tatra Mountains by T. Zwoliński, 1 : 40,000 (eastern sheet), printed in no less than 29 colors, of which 24 are hypsometric tints, these latter likewise being printed from three plates only. In addition the new process means a great saving of time—in the case of the small atlas only four months being needed to print a large edition which heretofore took six months to produce.

Periodicals Established by Professor Romer

Not only through maps but by means of text publications Professor Romer fosters the cause of Polish mapping and the cause of cartography in general. In 1923 he established the quarterly *Polski Przegląd Kartograficzny* (*Polish Cartographical Review*), a journal presenting in Polish, with French, English, and, recently, German résumés, articles on cartographic subjects and systematic reviews of maps published in Poland and elsewhere, especially the neighboring countries. In the series of geographic monographs edited by Professor Romer (*Prace Geograficzne* [*Travaux Géographiques publiés sous la direction de E. Romer*], Lwów and Warsaw) there are a number of papers dealing with cartography, and cartographic methods are extensively applied in the others whenever the geographical problems with which they deal lend themselves to such treatment. Professor Romer is also interested in the history of Polish cartography and was instrumental in organizing an exhibit of maps relating to Poland in the Polish Library at Paris during the International Geographical Congress in 1931.[7]

Cartography in the Universities

The publications discussed up to this point are of course not the only ones that are issued in Poland by private institutions or individuals, but they do represent a large part of such cartographic work. In order to provide a reasonably rounded

[6] A New Method of Cartographical Reproduction, *Polish Cartogr. Rev.*, [Vol. 5], Whole No. 35, 1931, pp. 61–66.

[7] E. Romer: Exposition de cartographie polonaise à Paris, *Polish Cartogr. Rev.*, [Vol. 5], Whole No. 37, 1932, pp. 159–166; see also his comments on the topic in his "The Cartographical Collection of the Royal Geographical Society, London," *ibid.*, No. 33–34, 1931, pp. 1–31, and the articles on Polish cartography of the fifteenth, sixteenth, seventeenth, and eighteenth centuries by B. Olszewicz, *ibid.*, Nos. 31, 36, and 38–39, 1930–1932.—A comprehensive review of Polish cartography from its beginnings in the fifteenth century through the post-war period is afforded by Wilhelm Hartnack: Entwicklung und Stand der Kartographie im Gebiet der Republik Polen, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1925, pp. 256–292, with bibliography. On the history of military cartography see B. Olszewicz: La cartographie militaire polonaise: Essai historique, 199 and lxxx pp., Inst. des Sci. Militaires, Warsaw, 1921, with French résumé.

picture of the country's map productivity since its rebirth mention should also be made of the two other main sources of cartographic activity, namely the university departments of geography and the government. Even so the picture will necessarily be far from complete.

At three of the Polish universities, those at Warsaw, Cracow, and Poznań, the departments of geography issue publications that provide an outlet for the work of the members of the faculty and advanced students. A survey of these three series, as well as of the above-mentioned *Travaux Géographiques* edited by Professor Romer, which reflects the work of the department at the University of Lwów, the *Polish Cartographical Review*, and other scattered geographical journals,[8] discloses a widespread application of the method of isopleth maps[9] (called isarithmal maps by the Polish school).

Isopleth Maps: Representation of Relative Relief

The most distinctive use of the method is in the representation of what is termed relative relief. In the application of this method the sheets of the topographic map covering the area or country under consideration are divided into small squares with sides equivalent, say, to five or ten kilometers in the field. Within each square two points, the highest and the lowest, are selected, and the resulting difference in elevation is inscribed on the square. These differences of elevation are then entered on a general map, and the appropriate contours are drawn to fit them in accordance with an intensity scale previously decided upon suited to the size and character of the area portrayed and to the scale of the map. The resulting picture indicates the degree of unevenness of the surface.[10] Such maps have been compiled and published of Poland as a whole,[11] of Poznania,[12] the Eastern Beskid Mountains,[13] the

[8] In accordance with their alternative titles in French each of these three series will here be cited as *Trav. Inst. Géogr. Univ.*———. Their present status is as follows: Warsaw, edited by S. Lencewicz, 14 numbers since 1924; Cracow, edited by L. Sawicki until his death, now by J. Smoleński, 12 numbers since 1923; Poznań (with subtitle "Études géographiques sur la Pologne du nord-ouest"), edited by S. Pawłowski, 7 numbers since 1926. The Lwów *Trav. Géogr.* consist of 15 numbers since 1918. Other periodicals cited are: *Czasopismo Geograficzne* (10 volumes since 1923), the journal of the association of Polish geography teachers, *Revue Polonaise de Géographie* and *Revue Mensuelle de Géographie*, organs respectively of the geographical societies of Warsaw and Cracow. For a comprehensive survey of Polish geographical and related periodicals see R. Danysz-Fleszarowa, *Czas. Geogr.*, Vol. 10, 1932, pp. 63–88.

[9] The method in general is discussed in F. Uhorczak: La méthode isarithmique appliquée aux cartes statistiques, *Polish Cartogr. Rev.*, Vol. 4, 1929–30, pp. 95–129 (French résumé, pp. 124–129), and its validity examined in M. Zdobnicka: La méthode des isarithmes au service de la graphique statistique, in Pokłosie Geograficzne (memorial volume dedicated to Professor Romer), Lwów, 1925, pp. 255–271 (French résumé, pp. 269–271). For American examples of the method as applied to agricultural statistics see the papers by Wellington D. Jones, "Ratios and Isopleth Maps in Regional Investigation of Agricultural Land Occupance," *Annals Assn. Amer. Geogrs.*, Vol. 20, 1930, pp. 177–195, with maps of the North-Central States of the United States, and "An Isopleth Map of Land Under Crops in India," *Geogr. Rev.*, Vol. 19, 1929, pp. 495–496, with map.

[10] The first published map broaching this method seems to have been a cartogram of the "relief energy," as he terms it, of Lower Silesia in 1 : 1,000,000 by Partsch in his "Schlesien: Eine Länderkunde" (Vol. 2, Breslau, 1911, opp. p. 586). On it he does not go beyond the weighting of the squares, however. The first published map to show relief energy by isopleths seems to be that of South Germany in 1 : 1,500,000 by Krebs in *Petermanns Mitt.*, 1922, Pl. 3. In the compilation of this map squares with 10-kilometer sides were employed, and sufficient salient points, sometimes as many as four, selected in each square to avoid a spacing of more than 5 kilometers between any two adjoining points. Eleven intensity grades are shown. Romer taught the method in his laboratory course at the University of Lwów in 1908–1910 (*Kosmos*, Vol. 36, 1911, pp. 529–532) and discussed it in a pre-war physical geography of Poland by 16 authors (Geografia Fizyczna Ziem Polskich, Acad. of Sci., Cracow, 1912; reference on pp. 9–14, with hypsometric map in 1 : 7,000,000). Apparently, however, no map of relative relief was published as a result of this work at that time.

[11] In *Trav. Géogr.* (Lwów), No. 13, 1931, by J. Ochocka, 1 : 2,500,000, 10-km. compilation squares, 22 intensities. (The paper itself discusses the method. The educational value of this map is underlined by M. Janiszewski in *Czas. Geogr.*, Vol. 9, 1931, pp. 67–70.)

[12] *Trav. Inst. Géogr. Univ. Poznań*, No. 4–5, 1929, p. 81, by J. Kamińska, 1 : 1,400,000, 6 intensities.

[13] *Czas. Geogr.*, Vol. 6, 1928, p. 6, by W. Kubijowicz, 1 : 2,500,000, 4-km. squares, 8 intensities.

Podolian plateau southeast of Lwów,[14] the lower Vistula region,[15] the riparian zone of the middle and lower Vistula,[16] and the southern Baltic.[17] A number of studies have also been made of contributory elements, such as river profiles[18] and average slope of land surfaces.[19] The relative-relief method yields valuable results especially in the case of flat country such as the Polish plain, where the ordinary hypsometric map gives an impression of monotony of surface which is not justified by the actual diversity of forms in nature. It is precisely in order to portray this diversity more adequately, and not as an end in itself, that the Polish geographers are experimenting with the method. This is the aim of the detailed and suggestive map of the surface-feature types of the North European Plain extending from the Oder to the Berezina and from the Baltic to the 51st parallel on the scale of 1 : 1,250,000 by B. Zaborski issued in 1928.[20] The same author has recently published a paper[21] in which he examines the whole question of the quantitative, mensurational approach to the study of land-form pattern and points out that, in addition to relative relief, there is need to take into consideration the density of occurrence of the surface forms. The various analyses of this type provide the elements for a culminating study, the establishment of natural regions. Such a subdivision into natural units, based on his own analysis, has been carried out by S. Pawłowski as regards Great Poland, or Poznania.[22] The detail of Pawłowski's map would seem to indicate that, here, close scrutiny applied to a relatively small area has disclosed the basic, indivisible units.

Other Topical Maps

Isopleth maps have been compiled to illustrate a number of other phenomena also. In physical geography there are maps of the snowfall of the winter of 1923–1924 in Poland—total amount, amount of the first and last snowfalls of the winter, depth of cover at certain dates, etc.[23] Economic geography is represented by isochronic maps of Galicia in 1914 and 1922[24] and an isopleth map of density of highways in Poland.[25] The nationalities question is illustrated in a map showing the relative "deficit" and "surplus" of Poles in Poland,[26] i.e. a ratio expressing the number of Poles that must be added to or subtracted from the population of a given unit of area where they are respectively in the minority or in the majority so as to make Polish half the population of that unit; and there is even an isopleth map showing

[14] Pokłosie Geograficzne (memorial volume dedicated to Professor Romer), Lwów, 1925, opp. p. 14, by J. Czyżewski, 1 : 500,000, 3.5-km. squares, 5 intensities.

[15] *Czas. Geogr.*, Vol. 9, 1931, p. 261, by S. Pawłowski, 1 : 1,700,000, 3 intensities.

[16] *Trav. Inst. Géogr. Univ. Poznań*, No. 2–3, 1927, pp. 40–41, by A. Gontarska, 1 : 2,600,000.

[17] *Ibid.*, p. 19, by M. Czekańska, 1 : 5,200,000, 4 intensities.

[18] M. Kołodziejska, *Trav. Géogr.* (Lwów), No. 14, 1931.

[19] J. Kamińska: Sur l'inclinaison du terrain dans la plaine, *Trav. Inst. Géogr. Univ. Poznań*, No. 4–5, 1929, pp. 77–90. On the graphic methods see J. L. Rich: A Graphical Method of Determining the Average Inclination of a Land Surface from a Contour Map, *Trans. Illinois Acad. of Sci.*, Vol. 9, 1916, pp. 195–199, and C. K. Wentworth: A Simplified Method of Determining the Average Slope of Land Surfaces, *Amer. Journ. of Sci.*, Ser. 5: Vol. 20, 1930, pp. 184–194.

[20] Reviewed in *Geogr. Rev.*, Vol. 20, 1920, pp. 349–350. The author published a simplified version on the scale of 1 : 5,000,000 (*Rev. Mens. de Géogr.* (Cracow), Vol. 8, 1930, p. 142) in arriving at a subdivision of Poland into natural regions.

[21] The Morphometric Analysis of the Relief of a Lowland Territory, *Trav. Inst. Géogr. Cracovie*, No. 12, 1931, with bibliography, English summary, and numerous sample maps. For a critical review of the whole question of morphometric technique as practiced by Polish geographers, see Strada Lucjan T. S.: Les problèmes principaux et les besoins de la morphométrie, *Polish Cartogr. Rev.*, No. 38–39, 1932, pp. 213–234, with French résumé.

[22] Grosspolens Oberflächengestaltung und Einteilung, *Trav. Inst. Géogr. Univ. Poznań*, No. 6–7, pp 137–172, with summary in German and land-form and natural region maps in 1 : 1,750,000 (pp. 140–141). This paper also discusses the maps by Ochocka and Zaborski mentioned above.

[23] *Czas. Geogr.*, Vol. 2, 1923–24, pp. 398, 399, 401, and 403, and Vol. 3, 1925, p. 73.

[24] *Trav. Inst. Géogr. Univ. Cracovie*, No. 1, 1923.

[25] *Czas. Geogr.*, Vol. 6, 1928, p. 98.

[26] *Trav. Inst. Géogr. Univ. Cracovie*, No. 6, 1926, insert map.

the degree to which place names have been subjected to Germanization in Poznania and Polish Pomerania.[27]

Of other maps emanating from university departments of geography those representing the following subjects are of special interest: distribution of nationalities in pre-war German territory with a Polish population (also separate detailed maps for Upper Silesia and Polish Pomerania) and in Polish Lithuania and White Ruthenia (dot maps);[28] distribution of religious faith in Eastern Galicia (dot map) and the Lwów district (by minor civil divisions);[29] building materials used in rural houses[30] and distribution of types of rural habitat in Poland;[31] population distribution and land classification in western Polesie;[32] and transhumance in the Tatra.[33] Although it is a government publication, there should be mentioned here an outstanding map on the scale of 1 : 1,000,000 by W. Deszczka showing the distribution of human habitations in Poland in 1921 by means of six types of solid black symbols classified according to the number of houses in each hamlet, village, town, or city.[34] In view of the fineness of the classification (1–10, 10–50, 50–100, 100–500, 500–1000, and more than 1000 houses) there results a strikingly detailed, and yet synoptical, picture of the distribution of population. Geographical, economic, and political factors are everywhere reflected in this distribution, an example of the last being the contrast between the relatively open distribution of larger villages (10–100 houses) and the close arrangement of single farms and small hamlets (1–50 houses) on both sides of the former German-Russian frontier, associated respectively with the manorial land tenure of the Prussian East and the small tenanted or owned farms of Western Poland. Owing to the small units of the lower brackets of the classification, the map tends to emphasize the rural population, and quite properly so in a predominantly agricultural state such as Poland. Nevertheless, the use of one symbol only for cities with more than 1000 houses somewhat hampers the portrayal of the urban population, as the same appeal to the eye is made by a city of 1019 houses and 17,000 people (Leszno, in Poznania) and one of 13,622 houses and 452,000 inhabitants (Łódź). In spite of the crowding of the village symbols, the major urban population might have been portrayed more adequately by means of De Geer's shaded sphere symbols.

Turning again to the university publications, there are, in the field of commercial geography, maps representing the number of passengers and amount of merchandise transported by the railroads of Poland in 1922 and 1928 and number of passengers in 1910 and 1923 and number of trains per day in 1925 on the railroads of Poznania.[35] Articles dealing with map technique discuss the measurement of such curved lines

[27] *Trav. Inst. Géogr. Univ. Ponań*, No. 1, 1926, p. 16.

[28] *Trav. Géogr.* (Lwów), Nos. 2, 4, 7, 1919–1920; *Trav. Inst. Géogr. Univ. Poznań*, No. 2–3, 1927.

[29] *Trav. Géogr.* (Lwów), No. 3, 1919; *Trav. Inst. Géogr. Univ. Varsovie*, No. 11, 1928, and *Rev. Polon. de Géogr.*, Vol. 8, 1928.

[30] *Czas. Geogr.*, Vol. 6, 1928, pp. 88 and 90–94; *Rev. Mens. de Géogr.*, Vol. 7, Cracow, 1929, p. 95.

[31] *Trav. Inst. Géogr. Univ. Poznań*, No. 6–7, 1931, p. 89.

[32] *Trav. Inst. Géogr. Univ. Varsovie*, No. 14, 1930.

[33] Maps accompanying Z. Hołub-Pacewiczowa: L'habitat et les migrations pastorales dans les Tatra et dans la région subtatrique, XX and 508 pp., Geogr. Commission of the Polish Acad. of Sci., Cracow, 1931, with French résumé, pp. 454–480, as follows: land and habitation classification, 1 : 75,000; economic and social organization of pastoral life, 1 : 200,000; migration routes from the sixteenth century to the present, and progressive seasonal occupation of the chalets (six maps). Apart from their intrinsic value, the maps and text are important from the standpoint of anthropogeographic method.

[34] Accompanies W. Deszczka: La répartition des maisons ainsi que la grandeur et la répartition des habitats en Pologne, *Rev. Trimestrielle de Statistique* (published by Central Statistical Office, Warsaw), Vol. 8, 1931, pp. 867–900, with French résumé.

A previous publication of the Central Statistical Office, the statistical atlas of Poland, has already been reviewed in these pages (*Geogr. Rev.*, Vol. 21, 1931, pp. 341–342).

[35] *Czas. Geogr.*, Vol. 7, 1929, p. 219; Vol. 8, 1930, p. 169; *Trav. Inst. Géogr. Univ. Poznań*, No. 2–3, 1927, pp. 118, 119, and 121. Mention may here also be made of five cartograms of Poland, 1 : 1,300,000, by Z. Dunin-Marcinkiewicz, representing by means of bands of proportionate width the export from Poland in 1927 of coal, mineral oils, lumber, poultry and dairy products, and the total amount of domestic freight movement.

as rivers, roads, boundaries, with an example of the determination of the length of the boundaries of Poland.[36] There are also articles on generalization in cartography,[37] the representation of changes in human agglomerations in time and space,[38] and field notation of house types.[39]

Government Topographic Maps

Among the maps published by the government the most important are, of course, the topographc sheets of Poland. The standard topographic map is on the scale of 1 : 100,000. There is also a smaller map in 1 : 300,000. These two series[40] and the Polish sheets of the International Map of the World are published by the Military Geographical Institute in Warsaw.

The 1 : 100,000 map is based on the relevant sheets of the pre-war topographic maps of Germany in 1 : 100,000, Austria in 1 : 75,000, and Russia in 1 : 84,000 and 1 : 126,000, and on the confidential map of Western Russia, i.e. Poland, in 1 : 100,000, prepared by the German General Staff before the war.[41] At first (1920–1921) a facsimile edition of these was published, with the place names restored to their Polish form. Then (1922–1924) a second edition of many sheets was published based on revision of the topography in the field. Now these are being superseded by still more thoroughly revised sheets. Of the 475 sheets that cover the territory of Poland, 215 have already been published in the latest version, which is either in two colors, contours in brown and the rest in black, or in four colors, contours in brown, drainage in blue, forest in green, and culture in black. With the previously published sheets of the second edition, topographic maps with uniform Polish nomenclature throughout and with revised relief in greater part are available for about nine-tenths of the country. Even though these maps are based mainly on already existing surveys, this is no mean accomplishment for a newly constituted state that has had little more than a decade of peace.

The 1 : 300,000 map, designated "for military operations," is a reproduction of the sheets that come into consideration of the map of Central Europe on this scale published before the war by the German Topographical Survey. Of the 38 sheets embracing Polish territory 21 have been issued. Where revised topography is available from the 1 : 100,000 series it has been incorporated.

International Map of the World

Of the six sheets of the International Map of the World in which the territory of Poland is embraced[42] four have already been published by the Polish government: N-34 (Warszawa), N-35 (Wilno), M-34 (Kraków), M-35 (Lwów). Editions of N-34 and of the other two have been issued by the interested adjoining states: N-33

[36] *Polish Cartogr. Rev.*, No. 37, 1932, pp. 145–153; *Czas. Geogr.*, Vol. 3, 1925, pp. 38–44; *ibid.*, Vol. 9, 1931, pp. 211–215 ("longimeter," instrument for measuring lines).

[37] Pokłosie Geograficzne (memorial volume dedicated to Professor Romer), Lwów, 1925, pp. 207–217.

[38] *Czas. Geogr.*, Vol. 10, 1932, pp. 11–28.

[39] *Rev. Mens. de Géogr.*, Vol. 9, Cracow, 1931, pp. 83–88.

[40] See *Polish Cartogr. Rev.*, Vol. 1, 1923–24, pp. 3–8, 193–205, and 259–263. These accounts, which are accompanied by index maps, and of which the last is based on an official report of the Polish Military Geographical Institute covering the period from the beginning, in 1919, to May, 1924 (*Rev. Polon. de Géogr.*, Vol. 7, 1927, pp. 82–86), are followed in the same journal by routine reviews of current sheets, with index maps brought up to date. The latest index maps of the 1 : 100,000 series are in No. 38–39, 1932, p. 236 (475-sheet version; see text, below) and Vol. 3, 1927–28, p. 194 ("second edition"); of the 1 : 300,000 series, in No. 29–30, 1930, p. 133. Hartnack, *op. cit.*, pp. 270–274, also discusses the new topographic maps.

[41] See Albrecht Penck: Polen: Eine Anzeige, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1918, pp. 97–131; reference on pp. 97–100.

[42] See E. Romer: On the History of the International Map of the World 1/M in Poland, *Polish Cartogr. Rev.*, Vol. 2, 1925–26, pp. 169–181, with English summary.

(Berlin) and N-34 (under the title "Ostpreussen") by the Topographical Survey in Berlin, and M-33 separately both by that survey (under the title "Wien") and the Military Geographical Institute in Prague (under the title "Praha"). While the Praha sheet does, the Berlin, Wien, and Ostpreussen sheets do not observe the regulation calling for the spelling of place names primarily in the official form of each country concerned.[43]

Conclusion

Even though rapid, this survey of post-war Polish cartography has been sufficient, it is hoped, to provide a reasonably representative view of what is being done at present in Poland in this field. The resulting dominant impression is one of vigorous growth and a high state of development, both in content and technique. Therein cartography, as geography's most distinctive mode of expression, reflects the advanced status attained by geography in Poland.

[43] The nonobservance of this regulation is, in a mimeographed statement dated October 24, 1932, implied as a principle officially followed by the German Topographical Survey in the publication by that organization of the five sheets that include the greater part of German territory. For this reason the latest sheet issued, Hamburg [= N-32] is designated as belonging to a series newly entitled "General Map (Übersichtskarte) of the German Empire, 1 : 1,000,000," and the implication is that the other four sheets already published, Berlin, Ostpreussen, München, Wien, will retroactively be assigned to this series. When published they bore, however, the regulation title "Carte Internationale du Monde au 1,000,000e."

AMERICAN GEOGRAPHICAL SOCIETY

The November Meeting. The regular monthly meeting of the American Geographical Society was held on November 22nd, 1932, at the Engineering Societies' Building, 29 West 39th Street, President Finley in the chair. Captain Robert A. Bartlett delivered an illustrated lecture on "Voyaging to Greenland." Since his last report to the Society (see "The Bartlett East Greenland Expedition," *Geogr. Rev.*, Vol. 21, 1931, pp. 398–414) Captain Bartlett has conducted two expeditions to Greenland. The moving pictures which he exhibited illustrated ice conditions in the Angmagssalik region of East Greenland in 1931 and on the coast of Labrador and West Greenland as far north as Cape York, where Captain Bartlett voyaged during the summer of 1932 on a commission to erect a permanent monument as a memorial by the Peary family to Admiral Peary, the discoverer of the North Pole. Captain Bartlett was introduced to the Fellows of the Society by Sir Wilfred Grenfell, who outlined the conditions on the Labrador and of his work there. Sir Wilfred was received enthusiastically as an old friend and as an associate in 1931 of Dr. Alexander Forbes of Harvard University in mapping the northern portion of the coastal region of Labrador, the expedition being under the auspices of the American Geographical Society of New York and the Royal Geographical Society of London. Sir Wilfred spoke feelingly of the help that Captain Bartlett had given on so many occasions to northern communities in distress and of recent reports of such aid during the last expedition and of families that would live through the ensuing winter in security "because Captain Bob had passed by."

At the meeting there were presented with the approval of the Council the names of 242 candidates who were duly elected as Fellows of the Society.

Exhibition of the "Atlas of the Historical Geography of the United States." During the months of January and February an exhibition of the "Atlas of the Historical Geography of the United States," a recent joint publication of the Society and the Carnegie Institution of Washington (see *Geogr. Rev.*, Vol. 22, 1932, pp. 353–360), will be held at the house of the Society. All the maps in the atlas will be on display, and a member of the Society's staff will be present to explain them to visitors. The exhibition will be for the benefit of Fellows and friends of the Society and of teachers of history and geography in the schools of New York City and vicinity who may wish to familiarize themselves with this fundamental publication.

The Captain Edmund Fanning Collection. In accordance with the wishes of her late husband, Mr. Sidney Bradford, for many years a Fellow of the American Geographical Society, Mrs. Mary M. Bradford of Avery Island, Louisiana, has presented to the Society a valuable selection of letters, notebooks, and books from a collection that descended to Mr. Bradford from his great-grandfather, Captain Edmund Fanning. The presentation was made at the Society by three of Mr. Bradford's nephews, Messrs. Gerard, Lindsay, and Douglas Bradford of New York, on November 23, 1932.

The items presented to the Society, which will be known as the Sidney Bradford Bequest, were selected from a collection that has been kept intact since Captain Fanning's death in 1841. They include copies of letters written and received by Captain Fanning in connection with his voyages and notes made at the time of his discovery of Fanning, Washington, and Palmyra islands; a number of notebooks and

account books dealing with his famous voyage in the *Betsey*, the first ship to sail around the world from the port of New York; a copy of the first American edition of the "Narrative of the Recent Voyages of Captain Ross to the Arctic Regions in the Years 1829–30–31–32–33"; and a copy of Captain Fanning's own book, "Voyages around the World," with marginal notes in pencil by the author.

New England's Prospect—1933. A volume entitled "New England's Prospect—1933" has just been issued (*Amer. Geogr. Soc. Special Publ. No. 16*). The title is borrowed from the first extended description of New England, William Wood's "New England's Prospect," published in London in 1634. The Society's book contains twenty-nine articles contributed by twenty-seven authors. Several broad fields of inquiry were outlined covering social, economic, and governmental conditions and problems in New England. Each contributor is a specialist in one of these fields and, in connection with it, was invited to discuss contemporary movements and issues that have appeared to him of the first importance. In the opening article Dr. James Truslow Adams interprets the New England character in the light of history. Other introductory articles deal with the regions into which New England may be split and with New England's industrial position and prospects in the large. The main part of the book consists of articles on specific problems: food supply, agriculture, forestry, fisheries, power, manufacturing, transportation, trade, rural and urban sociology, state and local government, and regional planning. Special attention is directed to the geographical circumstances that play an important part in all of these problems. The word "prospect" in the title carries two meanings, for the book provides not only "a view of things within reach of the eye" but also, to some degree, a "looking forward into the future."

The volume includes 500 pages and is illustrated with 48 maps and diagrams, nearly all of which were originally compiled for the purpose. Nine of the maps are on the scale of 1:3,000,000. Many of the articles are accompanied by extended bibliographical notes.

Distribution of Title Page, Contents, and Index of Volume 22 of the Geographical Review. The title page, table of contents, and index for Volume 22 of the *Geographical Review* (1932), which is issued separately, is ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

GEOGRAPHICAL RECORD

NORTH AMERICA

Emigration Versus Immigration in Canada. What does the growth of population in Canada owe to immigration? "Strange as it may seem, had we never had a single immigrant come within our borders since Confederation, 63 years ago, it is probable that our population would not be materially different from what it is . . . except when we had large areas of vacant land to be filled up very quickly, our immigrant population simply displaced the native born," says R. M. Lower presenting "The Case Against Immigration" (*Queen's Quart.*, Summer, 1930, pp. 557–574). The

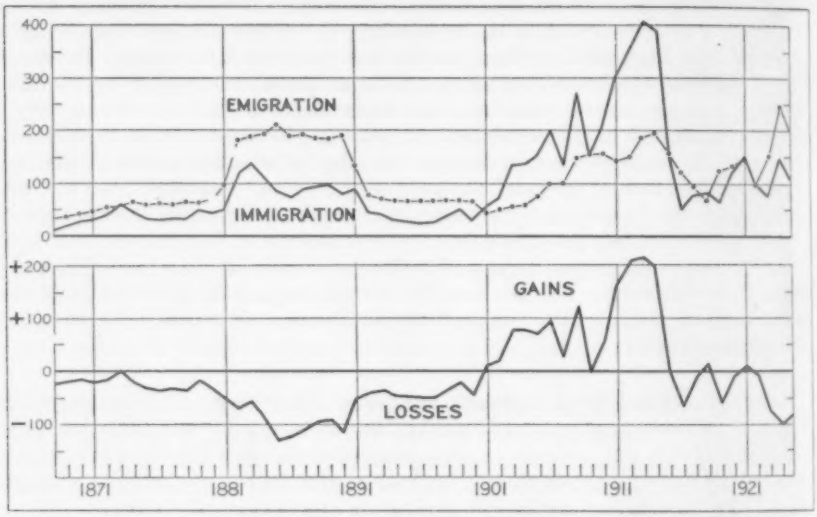


FIG. 1—The upper graph shows the progress of immigration into and emigration from Canada for the period 1868–1925; the lower graph shows the net gain or loss from migration. (After Professor Roland Wilson.)

populating of a country involves more than mathematics, of course; but, considering the numerical aspect only, Mr. Lower's contention is confirmed by Roland Wilson in "Migration Movements in Canada, 1868–1925" (*Canadian Hist. Rev.*, Vol. 13, 1932, pp. 157–182). Until recently no statistics of emigration have been kept—such is the difficulty of recording the movements of peoples across the four thousand-mile boundary between Canada and the United States—and until 1897 even statistics of immigration were not satisfactory. Professor Wilson explains the method by which he arrives at his estimate, and in an introduction to the paper Gilbert Jackson expresses the belief that it is unlikely the figures "will ever be modified so drastically as to distort really seriously the picture that he has drawn." The accompanying figure gives the picture. According to Professor Wilson's figures the net account of migration is a deficit to Canada of over 500,000.

The Belcher Islands and the New Hudson Bay Ports. "With the extension of the Temiskaming and Northern Ontario Railway to Moose Factory (Moosonee) on

James Bay and the near completion of the new harbor at Churchill, 700 miles to the northwest, a knowledge of the coast line and islands of Hudson Bay at once becomes of greater economic importance." This was the stimulus for the Canadian Government survey in the Belcher Islands in 1931, described by Captain Noel J. Ogilvie in "Geodetic Control for the Plotting of the Aerial Photographs of the Belcher Islands" (*Trans. Amer. Geophys. Union, Thirteenth Ann. Meeting, April 28 and 29, 1932*, National Research Council, Washington, 1932, pp. 64–68). The Belcher Islands, of which the first fair representation was made by R. J. Flaherty (The Belcher Islands of Hudson Bay: Their Discovery and Exploration, *Geogr. Rev.*, Vol. 5, 1918, pp. 433–458), lie some sixty miles off the east coast of Hudson Bay. Two hundred Eskimos live on the islands, and in the north-central area an iron formation of unproved commercial value is known to exist. The survey carried its triangulation net over this area, covered the archipelago with oblique aerial photography, and also established astronomical control points in the extreme south and east. It was discovered that the archipelago as depicted on existing maps is about 30 miles out of place, an error connected with the general displacement of the eastern coast of Hudson Bay 25 miles too far to the west.

Progress on the two new ports of the Hudson Bay region is described in recent articles in the *Canadian Geographical Journal*. The Temiskaming and Northern Ontario Railway reached tidewater 667 miles from Toronto in August, 1931. Arthur A. Cole completes his account of the economic possibilities of "Ontario's Route to the Sea" (*Canadian Geogr. Journ.*, Vol. 5, 1932, pp. 130–153) with a description of the terminal where a town site has been laid out a few miles from the site of the original fort of Moose Factory (Hudson's Bay Co.). The blacksmith's forge erected there in 1740 is said to be probably the oldest building in Ontario. We are likewise reminded of the early interest in the Churchill region, which dates back to the first decades of the seventeenth century, by Denzil G. Ridout in "Port Churchill" (*Canadian Geogr. Journ.*, Vol. 4, 1931, pp. 104–128). Among his illustrations is an excellent aerial photograph of Fort Prince of Wales built between 1733 and 1747 and in its day "one of most formidable strongholds of North America." The story of "The Founding of Churchill" is told by James F. Kenney in the book of this name (J. M. Dent and Sons, 1932), in which a substantial introduction gives the setting to the Journal of Captain James Knight, Governor-in-Chief in Hudson Bay from July 14 to September 13, 1717, here published for the first time. Besides its future as a port Churchill is likely to serve as an aerial base for northern prospecting. And thereby history is repeated, for it was from Fort Prince of Wales that Samuel Hearne in 1769 set off for the exploration of the copper country to the northwest of Churchill.

Moosonee is also a strategic point for an airplane base in mineral exploration, and it has been mentioned as a station on the proposed northern route to Europe via Greenland.

A New Population Map of the United States. Under this title Dr. F. A. Stilgenbauer presents a wall map compiled on the basis of the United States Census reports for 1930 (Rand McNally & Co., 1932). The map is on a scale of about 48 miles to the inch and is printed in black and white. State boundaries are shown, but no names or topographical features. Eleven insets on larger scales represent metropolitan areas of over 1,000,000 population. On the main map rural population is shown by dots, each dot indicating 2000 persons. Somewhat larger dots of uniform size show "rural-urban" centers of between 2500 and 15,000 inhabitants. For still larger places shaded circles are employed of sizes proportionate to the population represented. A feature open to criticism is the manner in which solid black is used. On the main map "metropolitan-urban" areas of over 650,000 inhabitants as defined by the Census Bureau are indicated in black. This tends to give an exaggerated impression of the density in the environs of certain centers, notably Boston and

Pittsburgh. On the insets the principal municipality in each case is shown in black, but these administrative areas bear no necessary relation to population. The city of Boston includes only a small part of metropolitan Boston. On a *population* map Staten Island with its sparse population should not appear in black unless the much more thickly settled parts of northeastern New Jersey are shown in the same manner. It would have been preferable to use black only for areas where the population exceeds a given density. The map as a whole, however, gives a clear picture.

A wall map entitled "Trading Center and Distribution Map of the United States" (scale 53 miles to the inch), has also been published recently by Rand McNally & Co. Four grades of population density are shown by counties, and cities of over 5000 inhabitants are indicated, according to size, by five different symbols. The title is misleading, however, as the map shows merely densities and distribution of population and nothing concerning trade or the distribution of commodities.

Michigan in Prehistoric Times. Of late years the staff of the University of Michigan Museums has been mapping the distribution of the Indian relics of Michigan. The results are presented by Wilbert B. Hinsdale in a magnificent "Archaeological Atlas of Michigan" (Michigan Handbook Series No. 4, Ann Arbor, 1931). The Atlas contains seventeen sectional maps of the state, showing Indian trails, villages, burying grounds, mounds, garden beds, and inclosures. Symbols for these are printed in red on a black base representing drainage, roads, towns, and boundaries. In the text, besides a general introduction, a brief account is given of the outstanding archeological features of each county.

The whole state was covered in a systematic manner; hence the villages and burying grounds mapped probably give a fair clue to the actual former distribution of Indian population. "The sparseness of population in some of the counties may be partially explained by the topography and other environmental conditions. In those parts the soil is very sandy or rocky, as in the Upper Peninsula, and non-productive of food for men and animals. Where there were heavy forests of pine and hemlock, other kinds of vegetation were scarce. The rivers were too swift and the lakes too pebbly to permit much of a growth of wild rice, an important food for Indians, and the fish were limited in kinds and size—a condition strongly in contrast, for instance, with that of the Saginaw and Grand River valleys." Parts of the sandy north-central interior of the Lower Peninsula were more or less of a no-man's land in Indian times.

"The unique contribution that Michigan makes to archaeology lies primarily in beds of material for a metallurgic industry. The natives developed considerable skill as miners and quarrymen." Copper for manufacture into "spears, knives, celts, wedges, beads, and other implements and ornaments" was found in veins and seams of the bed rock of the Keweenaw Peninsula as well as in nuggets ("float copper") carried south by the ice sheet. "In no other district in America did nature leave so abundant a quantity of metal that was particularly amenable to the crude workmanship of her primitive mechanics." (Compare G. A. West: Copper: Its Mining and Use by the Aborigines of the Lake Superior Region, *Bull. Public Museum, Milwaukee*, Vol. 10, 1929, pp. 1–184.)

Indian trails formed a network over the more thickly settled parts of the region. The routes have been reconstructed mainly from the field notes of early government surveyors. It is significant that most of the improved highways of the present time follow these routes. Michigan was connected by Indian trails with the Mississippi Valley, the Atlantic seaboard, and the Gulf of Mexico. Over these trails, as well as by waterways and portages, copper was transported from the Michigan deposits "to every state east of the Mississippi and even farther to the west and southwest." The waterways were as important as the forest trails, but owing to clearing and draining of the land many creeks open to canoes in Indian times have now vanished.

FIG. 1—Geographic regions of Wisconsin after Loyal Durand, Jr. Key: 1, Lake Superior Lowland; 2, Northern Forest, Hay, and Dairy Region; 3, Northwestern Sand Region; 4, Northern Lakes Country; 5, Northeastern Sand Region; 6, Northwestern Dairy Region; 7, Central Dairy Region; 8, Antigo Flats; 9, West Shawano Upland; 10, Northeastern Dairy Region; 11, Door Peninsula Fruit and Resort Region; 12, West-Central Maturely Dissected Region of Valley Culture; 13, Western Maturely Dissected Region of Ridge and Valley Culture; 14, Southwestern Maturely Dissected Region of Ridge Culture, and Associated Valley Culture; 15, Central Sand Plains; 16, Central Glaciated Sand Country; 17, Eastern Lake Shore Red Clay Dairy Region; 18, Fox-Winnebago Urban Belt; 19, Upper Rock River Valley Dairy Region; 20, Rock County Dairy-Corn Belt; 21, Southeastern Dairy Region; 22, Lake Shore Urban and Manufactural Belt.

The regions are superimposed on a photograph of the relief model of the state prepared by W. O. Hotchkiss and F. T. Thwaites and modeled by E. H. J. Lorenz, 1910.

Reference should also be made to Dr. Hinsdale's "Distribution of the Aboriginal Population of Michigan" (*Occasional Contribs. from the Museum of Anthropol. of the Univ. of Michigan*, No. 2, 1932) with a map of this distribution in relation to forest types and waterways.

Geographic Regions of Wisconsin. The "variety and beauty of the surface features of Wisconsin" are again before the reader in the second edition of Lawrence Martin's "The Physical Geography of Wisconsin" (*Wisconsin Geol. and Nat. Hist. Survey Bull. No. 36, Educ. Ser. No. 4*, Madison, 1932). Statistical material has been

brought up to date, and there is a new and strikingly different map of average annual rainfall by Eric R. Miller. The delimitation of the "five geographical provinces," which is primarily physiographic, remains as before. The division is naturally on broad lines, for Wisconsin is larger than England and is topographically diversified.

A detailed classification recently essayed by Loyal Durand, Jr., is shown in Figure 1. Map and brief characterization of the regions form a part of "Wisconsin Dairying" (by Walter H. Ebling, Samuel J. Gilbert, Gilbert T. Gustafson, Jr., *Wisconsin Crop and Livestock Reporting Service Bull. No. 120*, 1931). In his classification Dr. Durand shows a genuine respect for the natural landscape; but, as he also takes into account cultural features, the boundaries of his divisions are not permanent but will shift with changes in the use of the land. For instance, the Southeastern Dairy Region, which supplies whole milk to the Chicago and other urban markets, might be expected to encroach upon the provinces directly to the west.

In this one industry alone, as "Wisconsin Dairying" makes clear, the regional aspects of the state are revealed. Among the wealth of illustrative material, for instance, are dot maps showing graphically that Wisconsin has a rather uniform and dense cow population except in the central sand plain and the northern third of the state. Other charts and maps show that there is a regionalism in the use of the milk. In the areas adjacent to the Chicago-Milwaukee urban districts the milk is sold for immediate human consumption. The cheese industry, though widely dispersed, shows some concentration in the southwestern counties, in a section along the northern lake shore and adjacent to Green Bay, and in north-central Wisconsin. Butter manufacture is the predominant industry in the western part of the state and represents the eastern edge of the principal butter-producing region of the United States. An isopleth map by Helen I. Olson gives the ratio of milk production to acres of land in crops. It shows that in the southern two-thirds of the state a rather uniform relationship exists, but in the northern part there are small island-like areas where the yield of milk per acre of land devoted to crops exceeds four thousand pounds.

A detailed description and interpretation of one of the Wisconsin regions by Raymond E. Murphy has appeared under the title "The Geography of the Northwestern Pine Barrens in Wisconsin" (*Univ. of Wisconsin Papers in Geography No. 1; Trans. Wisconsin Acad. of Sci., Arts and Letters*, Vol. 26, Madison, 1931, pp. 69–120). This area of barrens is further regionalized into the Northeastern Hill Section, the Pitted Sand Plain, and the Southwestern Marsh. The typical barren land makes up, respectively, 52.8 per cent, 33.9 per cent, and 26 per cent of the three regions. Most of the remainder is in poor forest, but limited patches have been utilized for agriculture. The cultivated land amounts to only 1.3 per cent in the Northeastern Hill Section, 2.9 per cent in the Pitted Sand Plain, and 5.2 per cent in the Southwestern Marsh. In the two northernmost provinces clover and timothy predominate, but in the marsh section corn ranks first, occupying 28.7 per cent of the cultivated land. In this region the frontier has ceased to be an advancing line of pioneers conquering the wilderness; instead, it has become a condition of limited opportunities, impelling specialization in fur-farming, dairying, tourism, the growing of cranberries, and the cutting of jack pine for wood pulp.

Recently there has been published H. O. Lathrop's study of "The Geography of the Upper Rock River Valley of Wisconsin" (*Univ. of Wisconsin Papers in Geography No. 2*, Wisconsin Academy of Sciences, Arts and Letters, Madison, 1932). Within this northern portion of the Rock River drainage basin Dr. Lathrop has discovered a four-fold regionalism. He has delineated and described a southern region of general dairying which includes within its borders a tobacco district. To the northward dairying is still the dominant industry, and he has divided the area into a cheese district and a northernmost section of general dairying. GUY-HAROLD SMITH

Rainfall Intensity and the Drainage Problem in New Orleans. The heaviest rains in New Orleans are those of the spring storms, which exceed even the heavy falls produced by the passage of tropical storms (W. F. McDonald: Hourly Frequency and Intensity of Rainfall at New Orleans, La., *Monthly Weather Rev.*, Vol. 57, 1929, pp. 1–8). A record of 14 inches of rain in 19 hours occurred in April, 1927, or nearly a quarter of the average annual rainfall, 57 inches. In the same storm a fall of 20 inches in 24 hours was reported nine miles south of the city. The five-year period 1926–1930 was indeed remarkable for the frequency and intensity of great rainfalls, as George G. Earl points out in "Rainfall at New Orleans and Its Removal" (*Civil Engineering*, Vol. 2, 1932, pp. 289–294). Such a type of rainfall distribution has a peculiar significance for New Orleans because of the relation between the city and the adjacent bodies of water. Of the area of 44 square miles on which the larger part of the population dwells, one-third is at or below mean sea level and the level of Lake Pontchartrain; one-third is higher but below high tide or storm level of the lake; and the remaining third, still higher, is yet below high-water level in the Mississippi. Water introduced into the city area that is not evaporated must be removed by pumping, hence the importance of the frequency and duration rates in relation to rates of discharge. Mr. Earl publishes a chart showing the course of precipitation during record storms in the New Orleans district with comparable removal rates and urges the need of supplementary records to show how rain falls in heavy storms, for which he has devised a special type of rain gauge.

EUROPE

Social and Economic Problems of the Zuider Zee Reclamation. May 28, 1932, will long stand as the date of a major victory in the only war the Netherlands have been engaged in during the last one hundred years, the never-ending struggle with the water. On that day the one remaining gap in the great dike between Wieringen and the coast of Friesland was finally closed: the Zuider Zee ceased to exist; Yssel Lake was born.

After nearly twelve years of indefatigable labor the major technical difficulties of the reclamation project have thus been successfully surmounted (compare K. Jansma: The Drainage of the Zuider Zee, *Geogr. Rev.*, Vol. 21, 1931, pp. 574–583). The further completion of this great work will principally be a matter of time and of financial considerations. Meanwhile the social and economic problems growing out of the reclamation of the Zuider Zee are to the fore (H. N. ter Veen: Die soziale und wirtschaftliche Bedeutung der Abschliessung und Trockenlegung der Zuidersee, *Weltwirtschaftl. Archiv*, Vol. 35, 1932, pp. 594–611).

Among these the much discussed problem of the fishing industry of the Zuider Zee is of only minor importance. This industry never was a particularly lucrative one. Even including all those engaged in occupations directly dependent upon the industry the number involved did not exceed six thousand. The strongly seasonal character of the industry, the limited size of the fishing grounds, and the predominance of small, individual enterprises precluded any appreciable improvement in the condition of the fishing population. The disappearance of this industry, therefore, could not be considered a great economic loss. From a social point of view, however, the problem could hardly be left to solve itself, and the state undertook to assist the fishing population in moving or reëquipping their enterprises. Especially the younger generation have benefited from the provisions made for free or partly free tuition to all those who wished to fit themselves for other occupations. Although the fishing industry as it existed will have to be abandoned, it is unlikely that it will disappear altogether. The Yssel Lake, with an area of nearly three hundred thousand acres, will undoubtedly offer possibilities for the development of a freshwater fishery.

The reclamation project, when completed, will make available a total of about 550,000 acres of new and mostly very fertile clay lands, which must be considered a valuable addition to the agricultural area of a country as densely populated and as highly urbanized as the Netherlands. Between the years 1910 and 1921 the number of people actively engaged in agriculture increased only by 6 per cent, while the total population of the Netherlands increased by more than 17 per cent. The population of the cities is growing at an alarming rate—nearly 30 per cent of the population of the country living in cities with more than 100,000, and nearly 50 per cent in towns with more than 20,000 inhabitants. The western part of the Netherlands is gradually being transformed into one large urban area. But even then the average size of the individual agricultural holding is declining steadily (11.66 hectares in 1910; 10.89 hectares in 1921). The demand for land is so great that rents tend to increase beyond the point where a fair profit to the farmer is possible, even under a most intensive system of cultivation.

The reclamation project while it may alleviate cannot solve the population problem of the country. On the basis of the average density of rural population in the Netherlands the entire new area will be able to support from 250,000 to 300,000 people. The annual increment for the entire country is about 100,000, for the rural districts alone about 30,000.

More important than the quantitative side of the problem is the qualitative. As the examples of other reclaimed areas have shown, such regions of internal colonization tend to become centers of progress in agriculture. In new surroundings traditions are more easily abandoned, and the road is clear for experimentation and the introduction of new crops and new methods. Such a development may eventually greatly and favorably affect the agriculture of the surrounding regions. The outstanding example in this respect is the Haarlemmermeer polder, which was reclaimed during the years 1849 to 1852, and where the settlers have always shown a spirit considerably more progressive than that of the farmers in the neighboring areas.

The outright purchase of newly reclaimed land usually carries with it considerable economic risks. In the past colonization of such lands under the unbridled system of *laissez faire, laissez aller*, involved much suffering and considerable hardships for those who first attempted to settle. Even in conservative circles, belief in the unsurpassable efficiency of such an economic system is weakening, and everywhere new roads are being sought to draw optimum use out of capital and labor. Doubts have arisen regarding the social expediency of private property in land, even among those who prefer cultivation of the land by free *entrepreneurs* above an industry regulated by the state.

In a densely populated country like the Netherlands the danger of undue fractionation of the land is only too real. It is, therefore, generally considered advisable not to sell any of the new Zuider Zee lands but to give the land in hereditary tenure.

In the report of the government committee regarding the disposal of the Zuider Zee lands, direct government exploitation was opposed not so much as a matter of principle as for reasons of a practical nature. Since no precedent exists in the Netherlands, it was considered difficult to foresee whether such a system of exploitation would actually result in greater benefits for society as a whole. The committee therefore recommended that one-fourth of the Wieringermeer polder be set aside for an experiment with large-scale agriculture under leadership of the state.

Whatever mode or modes of exploitation may be chosen, the settlement of the new polders will be an attempt at planned economy, which, if successful, will undoubtedly prove of more than mere local importance.

W. VAN ROYEN

The Polish Tide Station at Gdynia. In connection with various oceanographic and hydrographic investigations, and more particularly for the purpose of deriving the plane of mean sea level which is the basic datum for elevations, the different

countries facing the Baltic Sea have established a number of tide stations along the shores of that sea. To coördinate this work the Third Hydrologic Conference of Baltic States, held in Warsaw in 1930, adopted a resolution looking toward the establishment of a network of tide stations along the Baltic coasts with distances of not more than 150 kilometers between stations. In accordance with this resolution the Polish Government has established a well equipped tide station at Gdynia, on the Polish coast of the Baltic, which was put into operation in January, 1931. The details of the establishment and of the instrumental equipment are described in a brochure of the State Hydrographical Service recently published in the Polish language with a full French summary entitled "Stacja Mareograficzna na Polskiem Wybrzezu Baltyku w Gdyni," Warsaw, 1932 (see also the official account of "L'institut national météorologique de Pologne" by its director, Jean Lugeon, Warsaw, 1932: Part III on "L'observatoire maritime à Gdynia).

The instrument used at this station is that devised several years ago by the Finnish oceanographers Henrik Renquist and Rolf Witting. This furnishes a continuous record of the height of the tide and will thus furnish not only the datum of mean sea level for the precise level net of the region but at the same time basic data for various oceanographic and hydrographic investigations, among which the changes in sea level and the changes in relation of land to sea are of special geographic interest.

H. A. MARMER

London Basin and London River. London one might perhaps describe as the product of the London Basin and London River. In "The Physiographic Evolution of the London Basin" (*Geography*, Vol. 17, 1932, pp. 99–116) Dr. S. W. Wooldridge traces the development of the area from early Tertiary times when there already existed a clearly marked synclinal basin drained by a stream analogous and ancestral to the present Thames. In detail the structure is complex: from the genetic standpoint the area can be considered as a series of maturely dissected plateaus forming a stairway "whose highest tread occurs on the bounding Chalk Downs and whose lower members are the familiar terraces of the Thames and its tributaries." The result is a mosaic of subregions for which London from its early days served as a focus. One of the more important of these subregions in early days because well suited to agriculture, the Essex Boulder Clay Plateau, Dr. Wooldridge elsewhere describes more fully (S. W. Wooldridge and D. J. Smetham: The Glacial Drifts of Essex and Hertfordshire, and Their Bearing upon the Agricultural and Historical Geography of the Region, *Geogr. Journ.*, Vol. 78, 1931, pp. 243–269). In addition to the reasons commonly advanced for the siting of London he adds another drawn from the relation of the site to the Essex drift area: farther east a broad belt of London Clay had to be crossed, in ancient times "heavily forested, dangerously impassable in winter and effectively waterless in summer," while farther west access was less direct.

From the beginning London has been a port, and in the life of the port the tidal régime of the waterway has played a dominant part giving advantages of particular importance in the earlier days. A curious instance of advantage taken of the tides in the estuary by mine-laying German submarines in the war is cited by D. Trevor Williams in "Some Problems of the Strategic Geography of London and the Thames Estuary (1914–1918) (*Scottish Geogr. Mag.*, Vol. 48, 1932, pp. 274–279).

The nature of the tides, the character of the channel and other physical characteristics of the river in relation to the habit of the port of London are the theme of "The Geography of London River" by Ll. Rodwell Jones (New York, 1932). Professor Jones is concerned chiefly with the developments since the beginning of the century, when the industrial revolution was leading to the rapid expansion of foreign trade and the growing tax on the natural capacity of the port began to call for modern engineering works. These twin aspects of the growth of the port he treats in illumina-

tive detail, of which a good summary is given by Professor Demangeon in the *Annales de Géographie* for September, 1932.

ASIA

"Manchukuo" and Mongolia. Early in 1932 a "Declaration of Independence" was proclaimed in Manchuria. The new state was named "Manchukuo" and the new capital established at Changchun (Hsinching). "For the purposes of local government 'Manchukuo' is divided into five provinces and two special districts," says the Lytton Commission's report to the League of Nations. "The provinces are Fengtien, Kirin, Heilungkiang, Jehol, and Hsin-An or Hsingan . . . The special districts are the old Chinese Eastern Railway, or Harbin, district, and the newly established Chientao or Korean district." This would imply a recognition of regional interests. Since the Lytton Commission was concerned with the Sino-Japanese controversy special consideration is given to the Korean problem and Chientao (compare Hoon K. Lee: Korean Migrants in Manchuria, *Geogr. Rev.*, Vol. 22, 1932, pp. 196–204). The brief mention of the Mongol problem may be supplemented by Owen Lattimore's article "The Unknown Frontier of Manchuria" in the contemporary number of *Foreign Affairs* (Vol. 11, 1933, pp. 315–330).

The Hsingan province is based on the Hsingan (Khingan) Mountains. It is divided into three sub-provinces, a northeastern division, including a part of the Nonni basin; a northwestern division, Barga; a southern or Cherim division named after one of the Mongol leagues. The area is "virtually a Mongol reserve." For the most part it lies west of the railways; there is, however, a Chinese outlier round Tungliao on the Tatung Railway which it is said will be governed by Chinese (Manchukuo) officials while paying land rent to the Mongols. The Mongolian boundary of Manchuria is vague. "Tribal boundaries exist, but are they to be recognized as national boundaries? Where can the physical frontier be defined? When it is defined, what will be the feeling and relationship between the Mongols included in Manchuria, those remaining under Chinese overlordship in Inner Mongolia, and the independent or quasi-independent Mongols of Outer Mongolia?" Outer Mongolia turned towards Soviet Russia for help and a "model for modernization" but "basically the new Outer Mongolia is no more communistic in feeling and instinct than China is republican." In Inner Mongolia the nomadic Mongols have for many years been retreating before the colonizing Chinese. The only part of Inner Mongolia proper not yet encroached on is the Silingol league, southwest of Hsingan, nominally part of Chahar Province, and this area is the stronghold of Mongol conservatism. The status of Jehol changes bewilderingly. This mountainous province is a key to northern China. Jehol has been colonized by Chinese settlers, but many Mongol islands survive. In the three Mongolias and Jehol the number of Mongols is estimated at some 3½ to 4 millions.

The situation of the Manchurian Mongols and Manchuria is viewed by Mr. Lattimore as part of a larger problem. He describes Manchuria as the eastern abutment and ocean gateway of the greater region of Mongolia, which itself is a boundary between "Continental Asia and Continental Russia," and he discusses the possibility of the revival of a Mongol state.

British Malaya: A "Dynamic" Census Report. The report on the 1931 census of British Malaya is of quite exceptional interest. In preliminary preparations and presentation of results alike the Superintendent, Mr. C. A. Vlieland, has taken "the dynamic standpoint" and gives a living picture of the country. For economic organization it was necessary to have some idea of the dimensions of the population to be enumerated: official estimates based on the 1921 census ("arithmetical" method) forecast four millions; published migration statistics suggested the possibility of "something like seven millions." An estimate made by the Superintendent in July, 1930, gave 4,320,000, and the actual count (April 1, 1931) was 4,385,346!

The outstanding feature of the demography of British Malaya is migration. To this "Eldorado in the eyes of neighboring peoples" come other Malayans (from Java, Sumatra, etc.), Chinese, and Indians (chiefly Tamils). Only little more than half the population is Malaya-born. Migration statistics, especially of emigration, are, however, faulty and easily lead to wrong deductions, for instance as to the natural increase of the Malay element of the population. Non-Malaysian immigrants for the most part are sojourners rather than settlers. The Chinese element increased by over 800,000 during the last two decades and now totals over 1,700,000, but the proportion of those who have been many years in the country is very small. With so heterogeneous a population there are difficulties in applying the ordinary categories of civil condition, race, and the like. These problems have been intelligently handled. Here is the definition of "race" "for census purposes," as far as it can be defined: "a judicious blend, for practical ends, of the ideas of geographic and ethnographic origin, political allegiance, and racial and social affinities and sympathies."

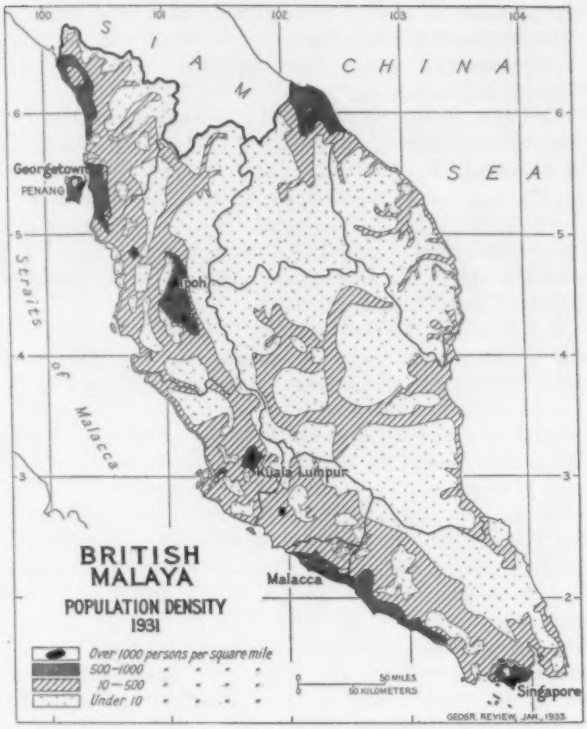


FIG. 1—Distribution of population in the Malay Peninsula, after the map on a scale of 18 miles to an inch accompanying the report on the 1931 census of British Malaya.

The geographical background against which Mr. Vlieland sets his figures is as skillfully interpreted. He makes particular protest against the designation of British Malaya as a "tropical" country, pointing out that temperatures of 90° F., with no appreciable seasonal variation and small diurnal range, and a humidity of 90 per cent are characteristics of an equatorial or marine-equatorial climate. His picture of conditions, it may be noted, is closely paralleled by C. F. Strickland's description of "Contrasts of the Indian and Malayan Countryside" in the *Journal of the Central Asian Society* (Vol. 17, 1930, pp. 43–54).

On the basis of the geographical background and with the aid of revenue maps showing alienated land, forest reserves, and the like (topographical maps not being available) a map of population distribution is drawn up for the peninsular region. This is in color and on a scale of 18 miles to an inch. A reproduction in black and white on a reduced scale appears as Figure 1.

Density of population "is not a matter of even gradation." The population is mostly included in the five classes: (1) urban, with a density of several thousand to the square mile; (2) continuous mining areas, with a density approximating 700 to

the square mile; and (3) continuous areas of small holdings, with a similar density; (4) estates and discontinuous small holdings, with a density approximating 150; (5) virgin forest and swamp, with a negligible population. "There is practically nothing between these densities."

Seventy per cent of British Malaya is primeval forest, the bulk of it east of the main divide. Only a single area of dense population appears in the east, the plain of Kelantan. Racially this is the purest part of the country; it is too rural to tempt the Chinese, its small-holdings system of agriculture is not attractive to the Indian, and it is too far for the Javanese or Sumatran to penetrate. The whole of the east coast suffers from inaccessibility and lack of good harbors and in every way contrasts with the west. The recent completion of the railway line between Singapore and Kelantan may, however, be noted.

It is chiefly of the west that Mr. Vlieland writes "it is exceedingly difficult to convey to the outsider anything resembling a true picture of British Malaya as it is today with its magnificent road system, its railways, its busy towns, its trim villages, and its highly organized social services. . . . Few would not be . . . surprised to learn that land in the heart of the city of Singapore may change hands at a figure higher than land in the immediate neighborhood of Piccadilly and that the standard price of virgin land for planting in the Federated Malay States is over £5 an acre." Aside from the urban areas, dense areas of population on the west coast are chiefly rice fields in the north with more complex cultivation in Malacca, the old established, and in Johore, with its recent growth. The latter state increased nearly 80 per cent in population in the last decade, mainly on account of the ease of passage from overpopulated Java. Inland, Kuala Lumpur, capital of the Federated Malay States, with a focal situation, stands out; and the Kinta Valley with its tin, "the abiding source of Malaya's prosperity." Elsewhere in the west rubber plantations and virgin forest, mostly reserved, alternate and reflect the north-to-south ribbed structure of the country.

In forecasting population developments due heed must be paid to the future of rubber. "One school of thought envisages the gradual elimination of 'estates' and the reversion of rubber growing to a native industry. . . . Another school looks forward with confidence to world consumption of rubber overtaking production, and the most optimistic even believe that in the not distant future yet more plantations will be required to meet the demand." In any event the opening up of virgin country is likely, for areas now open are "far nearer to saturation than is commonly supposed." The non-volcanic soil of British Malaya is relatively poor, contrasting unfavorably with the rich volcanic soils of Java; and additions to the population, whether arising from natural or migrational causes, would need to seek new land.

Fronts of the Bay of Bengal Tropical Cyclones. Fronts have been associated with extra-tropical cyclones by Bjerknes, but only recently has the India Meteorological Department found them associated with tropical cyclones in the Bay of Bengal. A few severe storms have been studied, and the data supplemented by excellent maps have been published (K. R. Ramanathan, A. A. N. Iyer, V. D. Iyer, V. V. Sohoni, H. C. Banerjee, S. Mal, and B. N. Desai, *Scientific Notes India Meteorol. Dept.*, Vol. 3, Nos. 18, 22, and 29; Vol. 4, Nos. 33, 34, and 39, Calcutta, 1931). The following is a summary of some of their findings.

There are three periods of tropical cyclones, the pre-monsoon (April–June), the monsoon (July–Sept.), and the post-monsoon (Oct.–Dec.). Of these the pre-monsoon and the post-monsoon cyclones are the most numerous and the most severe. These storms start in the Bay of Bengal or in the Pacific and enter the bay by way of the Gulf of Siam and the Isthmus. There is a formation of an active front at the meeting place of the southerly equatorial air and the northerly air, which is a preliminary to the formation of the depression in both pre-monsoon and post-monsoon types.

In the pre-monsoon cyclone the forepart of the advancing column of fresh southerly air is called the "monsoon front," or the "moist cold front," because it is associated with a fall of temperature and an increase of relative humidity. The warm dry air from the hot land at the north forms a "warm dry front" and ascends over the monsoon air when the two fronts meet. At an altitude of 3–4 kilometers the monsoon air will be warmer than the land air, so it spreads out into the region of land air. The pre-monsoon storms have strong winds and squalls occurring in advance of the dry warm front and generally in the monsoon sector.

In the post-monsoon storms there is an incursion of warm, humid air from the equatorial seas which meets the cold land air of northwest origin. This ascends over the cold land air, leading to the formation of a "warm front" much the same as is found in extra-tropical cyclones. During its northward movement the low is strengthened by its approach to the land, owing to contrasts between land and water. For example, the storm of November, 1926, shows a strong secondary cold front appearing as an occluded front, reënforcing the cyclone. Strong winds and squalls occur before the "moist warm front" in the post-monsoon storms.

The monsoon cyclones are about the same in origin and structure. They are disturbances on the quasi stationary front between the monsoon air in the Ganges plain and the dry northwest air.

In a study of the causes of the Calcutta thunderstorms by V. V. Sohoni it was found that they are not the local or heat variety of storms, with surface heating as their cause. These thunderstorms are associated with the passage of cold fronts in which there is an underrunning and consequent uplift of a saturated layer by denser air. Warm moist air from the bay supplies the lower layers in March, April, and May which is the thunderstorm season; and at 2–3 kilometers or higher there is the general northwest or westerly flow of colder air from the land. This massing of air of different properties results in instability and frequently in thunderstorms.

W. F. SMITH

HUMAN GEOGRAPHY

African Survivals in the New World. Among survivals of African culture, preserved in the New World a case close at home is to be found in the Sea Islands off the coast of South Carolina, the home of a group of negroes with as pure an African descent as can be found in the United States. These islands, especially St. Helena, were the scene of a sudden and complete transition from white to negro ownership when, at the end of the Civil War, the plantations were virtually turned over to the slaves. From that time until the present the Sea Islands have enjoyed an isolation so complete as to allow, for instance, the development of a distinct dialect, Gullah. But the construction of a modern highway has now destroyed this isolation, and, to record what is probably a fast disappearing culture, field studies were begun under the auspices of the Social Science Research Council and the University of North Carolina. T. J. Woofter, whose "Black Yeomanry" (1930) is a summary of this investigation, concludes: "Looking at the folk culture of St. Helena in a broad way one is led to the conclusion that the outstanding thing about it is the way in which geographical and cultural isolation have made for the survival of old culture patterns both European and African. . . . The segment of Negro culture which comes nearest to being a replica of African culture is found in the animal tales. . . . " The Gullah dialect and folk tales are given in "Folk Culture on St. Helena Island, South Carolina," by Guy B. Johnson (1930). "A Social History of the Sea Islands," by G. G. Johnson (1930), completes the trio. The negro population of the island declined from 8285 in 1900 to 4458 in 1930. A study of the process of migration by Clyde Vernon Kiser (Sea Island to City: A Study of St. Helena Islanders in Harlem and Other Urban Centers, New York, 1932) points to the same causes as are responsible for the general drift from country to city.

"The Ile à Gonave offers an excellent field of study to those interested in primitive society or in African inheritances among New World Negroes." R. B. Hall in "The Société Congo of the Ile à Gonave" (*Amer. Anthropologist*, Vol. 31, 1929, pp. 685–700) describes the interesting secret societies that dominate the economic and social life on this isolated Haitian island. "The Société Congo is primarily a coöperative agricultural society. It has, in addition, social, protective, and benevolent functions. In its organization and operation, influences of American Indian, French, and African cultures can be seen. . . . The organization and origins of the Société Congo appear to be primarily African."

In Surinam a tropical forest environment provides the virtual isolation in which the unique culture of the Djuka or Bush Negro has developed. Brought directly from Africa to the plantations of Surinam, many slaves managed to escape to the bush. There they found an environment somewhat similar to that of their still-remembered African home, and there they have developed a form of African culture slightly modified by their contact with the whites and the Guiana Indians. From the bush the escaped slaves harrassed the white planters so successfully that the authorities were forced to treat with the former slaves, and to this day an annual subsidy is paid to the Djukas, the first new people in the western hemisphere to establish their independence.

Morton C. Kahn, who has made three visits to these people for the American Museum of Natural History, has recorded his experiences in "Djuka" (New York, 1931). In 1927 he made a special study of the Saramaccaners, a tribe that inhabits the lower Saramacca and the Middle and Upper Surinam rivers (*Amer. Anthropologist*, Vol. 31, 1929, pp. 468–490). M. J. Herskovits, leader of the Northwestern University expeditions to Surinam in 1928 and 1929 is engaged in determining the African origins of the New World negro. He feels it "admissible to state that the region from which they came centers about Loango, Dahomey, Nigeria and the Gold Coast. Some of the clans . . . represent definite African groupings" (*De West-Indische Gids*, Vol. 11, 1930, pp. 393–402). In seeking further links between the Djuka and the West African negroes Dr. Herskovits visited Africa in 1931 (Some Aspects of Dahomean Ethnology, *Africa*, Vol. 5, 1932, pp. 266–296).

Gold Production. A "rich gold discovery" in The Granites, 400 miles northwest of Alice Springs, Central Australia; a new alluvial gold field on the Guiana border of Venezuela; the new Kakamenga gold field in western Kenya on which Sir Albert Kitson reports favorably—these three headliners of current news are symptomatic of the world-wide gold fever of the day. Governments, financiers, and economists are in a state of concern over the adequacy of future supplies of the precious metal, a commodity unique "in virtue of a peculiar and concerted psychological regard in which it is held," to use the expression of Dr. L. C. Graton in a comprehensive paper that passes from the economic perspective and the present status of gold production to consider the future (Future Gold Production—The Geological Outlook, *Trans. Amer. Inst. of Mining and Metallurgical Engineers*, 1931, pp. 534–557). There is no agreement in predictions on the future. The world's record production was made in 1915 with 22,737,520 ounces. Early returns are said to indicate that the figure for 1932 will exceed the record (S. D. Strauss: The Gold Supply Increases, *Engineering and Mining Journ.*, Vol. 133, 1932, pp. 210–214). But is this a flash in the pan? Has a definite decline set in? Mr. Joseph Kitchin holds that the prospects are not bright (Gold Production, in "The International Gold Problem: A Record of the Discussions of a Study Group of Members of the Royal Institute of International Affairs, 1929–1931," London, 1931, pp. 56–68), though his forecast of a production of 18,500,000 ounces by 1940 is somewhat more liberal than that of the Financial Committee of the League of Nations in its interim report of 1930 (compare G. F. Loughlin: Precious-Metal Supplies and the Price Level, in "Mineral Economics:

Lectures under the Auspices of the Brookings Institution," New York and London, 1932, pp. 251–276). The tenor of Dr. Graton's paper is more hopeful. True, three unfavorable circumstances can be pointed out—the mere passage of time, the magnitude of recent production, and the dominance of a single producer, the Rand, which, as another writer, F. Lynwood Garrison, points out, has in 40 years yielded one-fourth as much gold as has been produced in the whole world since the discovery of America.

Dr. Graton discusses possible improvements in mining and metallurgy of gold and in prospecting. He notes that aerial prospecting has been chiefly of value in transportation to mines and in the discovery of surface outcrops, whereas at present and in the future deep-seated deposits would seem to be of greatest importance. There is a field for the interpretation of large-scale geological relationships and structure by aerial photography. The fate of gold production must for some time be determined by the performance of South Africa, and the prospects are less gloomy than has been commonly thought. Recent despatches, it may be noted, report the discovery of a forty-mile extension of the famous Witwatersrand reef. The gold fields of southeastern New Guinea are interesting geographically for the dependence on aerial transportation as well as for their promise as gold producers (see the mandatory Report to the Council of the League of Nations on the Administration of the Territory of New Guinea for the year 1930–1931, Canberra, 1932). Thorough prospecting in the Gold Coast is urged by the former director of its geological survey, Sir Albert E. Kitson, who points out that costs of production are lowered and speaks favorably of the Tarkwa-Abosso field, an auriferous conglomerate that presents close similarities to the banket of the Rand (The Gold Resources of the Gold Coast, *United Empire*, Vol. 23, 1932, pp. 83–88).

Regional prospects of gold production are bright in Canada. Here the activity of prospectors has led the government to anticipate the detailed study in course of preparation with "Gold Occurrences of Canada: Summary Account," by H. C. Cooke and W. A. Johnston (*Canada Geol. Survey, Econ. Geol. Ser. No. 10*, 1932). Gold holds second place in the mineral production of Canada, and Canada now holds second place in the world production of gold, having outranked the United States in 1930. About 45 per cent of Canada's total output up to 1930 and 90 per cent of its present output is credited to the Canadian Shield. The total area of the Shield is 1,825,000 square miles, of which only the southern end has been prospected with any thoroughness. But the report warns against the assumption that the more northerly parts will prove as productive as the south. Preliminary traverses have shown that immense areas are underlain by apparently barren granites. "It is probably true that not more than 10 per cent of the northern part of the Shield is underlain by rocks in which mineral deposits are likely to occur." However, even this represents a large area.

HISTORICAL GEOGRAPHY

The Columbus and Magellan Concepts of South American Geography. "It has been so much the fashion in the last forty years for critical scholarship to cast doubts of one kind or another on the enterprise of Columbus that it has seemed necessary to assemble in one place the more important data in regard to the time at which Columbus came to the conclusion that Asia was not far distant from Europe and why he so reasoned." This George E. Nunn has done in a study "The Columbus and Magellan Concepts of South American Geography" (privately printed, Glenside, 1932).

The gist of his thesis may be stated as follows. Ptolemy had believed that the known world extends over 180 degrees of longitude from the prime meridian of the Canaries to eastern Asia. He had also thought that the Indian Ocean is completely

surrounded by land. Marco Polo demonstrated that an ocean lies east of Asia and is connected with the Indian Ocean. Hence, on the famous Behaim globe of 1492, which combines the geography of Ptolemy with that of Marco Polo, the Indian Ocean is shown as merging with the ocean to the east. Ptolemy's lands east of the Indian Ocean, however, are retained in the form of a great promontory projecting far south from the southeastern corner of Asia. Another result of Marco Polo's travels is also shown on Behaim's globe—the addition of 60 degrees to the longitude of Asia. Columbus had not actually seen Behaim's globe; but the globe, except for one important point, reflects the geographical theory on which he apparently based his plan for the first voyage. The exception is that Columbus shortened the length of the degree, thus reducing the distance from the Canaries to Zipango, or Japan, to about 62 degrees or only 775 leagues. Consequently it seemed to Columbus a relatively simple matter to reach Asia by sailing west.

In a volume published in 1924 by the American Geographical Society ("The Geographical Conceptions of Columbus") Nunn set forth this thesis, and it is further elaborated in the little volume under review. In addition, evidence is presented to show that two theories prevailed early in the sixteenth century in regard to South America. According to one theory that continent was identified with the southeastern promontory of Asia that figures on Behaim's globe. The other view was that South America is a huge island wholly unconnected with Asia. Magellan, it would seem, accepted the first theory. Otherwise, Nunn argues, he would hardly have sailed so far north after passing through the strait but would have taken a more westerly course in order to circumvent the southern end of the hypothetical Asiatic promontory which still presumably would have lain in his way. His failure to encounter this promontory on his voyage across the Pacific seemed to his contemporaries definitely to prove that South America is a part of Asia, and "after Magellan's voyage it was so represented cartographically for more than twenty-five years."

Some Geographical Studies Made for Cosimo de' Medici. Under the rule (1537–1574) of Duke Cosimo de' Medici, who enjoyed the support of the Hapsburg emperors in Austria, Florence became the most powerful Italian state. A strong navy and a large merchant marine were built up; Florentine trade flourished throughout the Mediterranean and western Europe, and commercial relations were extended to the Far East and America. Cosimo was intensely interested in maritime affairs. At his naval station at Pisa he maintained what we should now call a hydrographic office, where charts were drawn and pilot books prepared for the benefit of sailors. The unpublished manuscripts of two of the more notable of these pilot books, or *portolans*, are now preserved in the National Library at Florence. One of these, entitled "Portolano delle Indie Orientale ed Occidentale" is in part a translation from the Portuguese and in part the original work of a Florentine nobleman and traveler, Bernardo Baroncelli. It gives a minute description of ports, sailing routes, currents, marine hazards, etc., on the trade routes eastward to China and the Indies and westward into the New World. The other, "Cosmographia Universale," is more elaborate. Although anonymous, it was undoubtedly written by Baroncelli. Probably "the most complete contemporary description of all the coastal regions of the world explored to 1563," it is much more than the usual portolan. It constitutes, indeed, a geographical treatise of the first rank. Other "cosmographies" of the period are for the most part mere compilations from the writings of many authors. The "Cosmographia Universale" is based almost wholly on first-hand observation and on information gathered directly from sailors, merchants, and other travelers. Baroncelli might be likened to a Florentine Hakluyt. His "Cosmographia" contains an amazing fund of details on questions of applied astronomy and navigation, physical geography, climates, flora and fauna, history, politics,

military affairs, and economic and commercial geography. Professor Crinò has made available the first extended statement and critique covering the contents of this extraordinary manuscript (Sebastiano Crinò: Portolani manoscritti e carte da navigare compilati per la Marina Medicea: I, Portolani di Bernardo Baroncelli, *Rivista Marittima*, Suppl. to Sept. number, 1931, Ministero della Marina, Rome, 1931).

Professor Crinò also discusses certain maps of the same period drawn by the Portuguese Lopo Homen, a member of a distinguished family of cartographers (*ibid.*, II, Le carte da navigare conservate nel Museo degli Strumenti Antichi di Firenze e la Carta di Lopo Homen posseduta dal Duca Salviati di Migliarino (Pisa), Ministero della Marina, 1932). It is likely that these maps, which were made in Lisbon, were acquired by or for Cosimo de' Medici.

Alexander the Great in India. No other man has done more to throw light on the secrets of innermost Asia than Sir Aurel Stein, who now has set himself the task of deciding the point at which Alexander crossed the Hydaspes (modern Jhelum) to win a victory over Poros, as the Greeks called the great Paurâva king, one of the most brilliant feats of strategy in his entire career (The Site of Alexander's Passage of the Hydaspes and the Battle with Poros, *Geogr. Journ.*, Vol. 80, 1932, pp. 31–46). Alexander's advance into the Punjab derives further interest from the fact that it was the first of the many invasions of India from the northwestern frontier recorded by history and also because of its effects upon the culture of India.

The details, preserved mainly by Arrian, are briefly these: Leaving Taxila (the Takshasila of early Indian texts and identified by General Alexander Cunningham with the ruined site of Shahki-dheri, between Hassan Abdal and Rawalpindi), Alexander must have proceeded by way of the Salt Range to the Hydaspes, where he found Poros, with a large army, awaiting him. It was early summer (326 B.C.), and rains made fording impossible. Alexander marched from his camp with a select force 150 stadia (17½ miles) to a headland, where the river made a great bend. Here there was a deep ravine, in which soldiers and horses might hide, and in the river there was a large island. At dawn Alexander began to cross but, through ignorance of the locality, landed not on the mainland but on another island. The delay gave Poros an opportunity to reach the scene and deploy his army. The battle must have been fought on a large plain, for Poros' front line of infantry alone stretched over four miles. After a great victory, Alexander founded a city, Nikaia, on the battlefield in honor of his success, and another, Boukephala, in memory of his famous charger, at the point whence he had started to cross the Hydaspes.

Sir Aurel Stein made a close study of this region in the last months of 1931. Various identifications suggested by scholars in the past were obviously wrong, for not one of them fitted all the conditions. Sir Aurel shows in his article that Alexander, leaving Taxila, crossed the Salt Range by the pass of Nandana, to the west of the Grand Trunk Road. This brought him to the village of Haranpur, where the Hydaspes offers an excellent crossing place, and here he made his camp. A road leads from Haranpur to Jalalpur, exactly 17½ miles away. At Jalalpur there is a headland overlooking the river at a marked bend; there is the ravine of Kandar Kas and a large island opposite Jalalpur. That Boukephala was built where now stands Jalalpur is further confirmed by antiquities discovered there. Somewhere on the broad plains across the river Alexander founded Nikaia, but no ruins remain to indicate its exact position.

C. A. Robinson, Jr.

EDUCATIONAL GEOGRAPHY AND METHODOLOGY

The Spelling of Foreign Geographical Names. The problem, perplexing even to geographers, of how to spell foreign geographical names has been brought to a

solution for American users by a recent report published by the United States Geographic Board ("First Report on Foreign Geographic Names," 113 pp., Washington, 1932). Always difficult, the question was made more complicated by the territorial changes that followed the World War, and it has increasingly called for regularization. A committee was appointed by the Board four years ago consisting of two of its members, Mr. S. W. Boggs, geographer of the Department of State and chairman of the Board's executive committee, and Dr. Helen M. Strong, geographer of the Bureau of Foreign and Domestic Commerce, Department of Commerce. Drawing into consultation a wide circle of linguists, lexicographers, geographers, business men, and publishers, they and their colleagues of the Board, of which Mr. Frank Bond, formerly of the General Land Office, is chairman and Mr. John J. Cameron is secretary, have produced an admirably balanced work, practical and yet scholarly. Although the decisions of the Board are only binding on the departments and establishments of the Federal Government they are bound to find widespread acceptance in the country as a whole. It is of historical interest to note that the early interdepartmental exchanges that led to the establishment of the Board in 1890 by Executive Order found their first fruition in a report by the Hydrographic Office of the Navy on precisely the same topic ("Report on Uniform System for Spelling Foreign Geographic Names," 89 pp., Washington, D. C., 1891).

The bulk of the report (pp. 42–113) consists of an alphabetical list of some 2500 names of countries, cities, provinces, rivers, and other natural features in all parts of the world except the United States and its possessions. In bold face type are printed the spellings approved by the Board. As cross references are given, in ordinary Roman type, forms in a language other than that of the country concerned, for example "La Haye," the French name of The Hague, and, in italic, rejected names or spellings, so that every feature listed is readily identifiable under one of its spellings. Under each bold face name is given a brief characterization of the feature it represents together with its latitude and longitude.

The first section of the report (pp. 3–30) discusses the problems involved in spelling foreign geographical names, the policy adopted by the Board, and the rules established. As a result of its consideration of the numerous problems, theoretical and practical, the Board adopted six rules for its guidance in arriving at its decisions. In brief, these rules provide for the use (1) of conventional English names for countries, for geographic features straddling two or more countries, and, alternatively, for certain local names; (2) of "local official" names for local names in countries in which a Latin alphabet is used, including use of accents and diacritical marks; (3) transliterations, for non-Latin alphabet names (a) according to official transliteration where such is provided, or (b) according to a letter-for-letter transliteration scheme where an official transliteration is not provided.

Thus the decisions call for the use of (1) "Poland" and "Finland" instead of "Polska" and "Suomi," of "Pyrenees" and "Danube" instead of terms by which these features are known in the countries in which they are located, and the alternative use of such names as Florence for Firenze and Munich for München; (2) of Cetinje and Łódź and Plzeň; of (3a) Anhwei and Tokyo and Asyût; and of (3b) Chelyabinsk and Blagoveshchensk.

In the matter of transliteration the United States Geographic Board follows closely the principles established by the British "Permanent Committee on Geographical Names," thereby insuring substantial uniformity throughout the English-speaking world. The transliteration table (to be used for spelling in the case of non-Latin alphabets and as a guide to pronunciation with reference to languages that employ the Latin alphabet) published by the Board (pp. 33–36) is practically the same as that of the British committee (so-called "RGS II System") except for the symbols used to represent the sounds of the letter "j" as used in English and French respectively. The British key uses "dj" for the former and "j" for the latter;

the American key, wisely, we believe, "j" and "zh" respectively. There is also a Russian transliteration table (p. 20) and a table of equivalent values of consonantal sounds in a number of Latin-alphabet languages that do not occur in Latin.

The obligatory use of diacritical marks and accents on names in languages using the Latin alphabet is a direct reversal of the Board's earlier policy (see Fifth Report of the United States Geographic Board, 1890 to 1920, Washington, 1921, pp. 14 and 19). This reversal, it would seem, is the inevitable result of the closer scrutiny of the linguistic questions involved—a scrutiny brought about by our closer contact with European problems during and since the World War. It would be a fortunate consequence if this experience should help clarify and lead to a reconsideration of some of the minor points of domestic spelling and usage now officially in force, notably the omission of the apostrophe in possessives (e.g. Youngs Point) and (not within the province of the Board) the omission of the definite article before river names when these are followed by the word "River" and before an adjective modifying "United States" (e.g. "on Colorado River," "in central United States"), which are contrary to the spirit of the English language and linguistic principles in general.

GEOGRAPHICAL NEWS

The Cape Geographical Society. Announcement is made of the organization of the Cape Geographical Society. The seat of the Society is in Cape Town. As its medium of publication the Society will use the *South African Geographical Journal*, Johannesburg. The president for 1932–1933 is Sir Herbert Stanley; secretary and treasurer, Mr. J. W. Nankivell, Diocesan College, Rondebosch.

OBITUARY

Louis Agricola Bauer. Dr. Louis A. Bauer, director emeritus of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, died on April 12 at the age of 67. The September (1932) number of *Terrestrial Magnetism and Atmospheric Electricity*, of which magazine he was the founder, is dedicated to him. This memorial issue includes tributes from former associates in all parts of the world and a number of papers on phases of the work to which he had devoted his energies. Three accomplishments, says Dr. N. H. Heck, constitute "a three-fold monument to his memory": ". . . the development of a world-wide viewpoint of the problems of terrestrial magnetism. His establishment of the International *Journal of Terrestrial Magnetism and Atmospheric Electricity* has done much to contribute to such a viewpoint and to coördinate international activity; . . . the organization of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington; . . . the part which he took in developing the standards of accuracy in magnetic work and the magnetic work itself of the United States Government through the Coast and Geodetic Survey."

Robert Lee Faris. Robert Lee Faris, assistant director of the Coast and Geodetic Survey for almost eighteen years, died at Washington, D. C., on October 5, 1932. His early surveys included work on the Missouri River and the Yukon Delta. Later on he served in Puerto Rico and on assignments to various parts of the Atlantic coast of the United States. In 1906 he began magnetic work and followed this with the supervision of hydrographic and topographic surveys. His isogonic chart of the United States with secular change tables showed the distribution of magnetic declination in the United States for January 1, 1910. In 1919 he became a member of the Mississippi River Commission. His services to the National Research Council and to the Federal Board of Surveys and maps were both varied and substantial.

Sir Everard im Thurn. Sir Everard im Thurn, who died in Prestonpans, Scotland, on October 8, 1932, at the age of 80, made his name in British Guiana. He will be remembered among geographers especially for his book "Among the Indians of Guiana" (1883) and for his ascent of Roraima, the first conquest of this mountain (compare G. H. H. Tate: Notes on the Mount Roraima Region, *Geogr. Rev.*, Vol. 20, 1930, pp. 53–68). Later he held colonial appointments in Ceylon and Fiji. Knowledge and sympathy made him eminently qualified as administrator over a people of backward culture. His insight into the problems of primitive peoples is illustrated in his presidential address "On the Thoughts of South Sea Islanders" before the Royal Anthropological Institute in 1920. With Leonard C. Wharton he edited for the Hakluyt Society "The Journal of William Lockerby, Sandalwood Trader in the Fijian Islands during the Years 1808–1809" (1925), which *Nature* informs us (No. 3286, Oct. 22, 1932, p. 603) was considered by Sir Everard himself to contain his best work.

Edwin R. Heath. Dr. Edwin R. Heath, a Corresponding Member of the American Geographical Society, died on October 27, 1932, at Kansas City, Mo., at the age of 93. His exploration of the Rio Beni—descent in 1880 to its junction with the Mamoré and ascent in 1881 from Reyes to La Paz—was a notable geographical achievement for which he was honored by the Bolivian government by election to the Order of the Condor. His journeys are described in the *Bulletin of the American Geographical Society*, Vol. 14, 1882, pp. 117–165.

General Nicola Vacchelli. A cablegram received by the American Geographical Society November 21 announces the death of General Nicola Vacchelli, director of the Istituto Geografico Militare, Florence. Italy thus loses one of her most distinguished geographers. Under General Vacchelli's energetic direction the Istituto made valuable contributions to geography transcending the usual limits of geodetic and topographic work, notably in the publication of *L'Universo*, founded in 1920, and including geographical articles of broad interest.

General Vacchelli was president of the Reale Società Geografica Italiana and of the Comitato Nazionale per la Geografia (see his report "L'opera della R. Società Geografica Italiana dal 1928 al 1930," *Atti dello XI Congresso Geogr. Italiano*, Vol. 1, Naples, 1930). He also served as president of the International Geographical Union, succeeding Prince Roland Bonaparte in 1924, and his gracious presidency over the meetings held in Cairo (1925) and London and Cambridge (1928) will be remembered.

GEOGRAPHICAL REVIEWS

Economic Conditions and Prospects in China

J. B. Condliffe. **China To-Day: Economic.** 214 pp.; maps, diagr., index. World Peace Foundation, Boston, 1932. $2.50. 8 x 5½ inches.

The raw material for any serious study of the economy of a country in this age is statistical. One seeks to learn the number of the population, the distribution of employment, the standard of living. Then more specific facts are sought in the indices of wholesale prices, car loadings, bank deposits, the circulation of the currency, the volume of domestic and foreign trade, and the like. But in China such statistics are almost entirely lacking. What figures there are represent only a small segment of Chinese economy and most of these are little better than rough approximations: the mean of a number of intelligent guesses. Thus the task which Mr. Condliffe has undertaken is an extremely difficult one. That he has succeeded in presenting in understandable form for the lay reader the main outlines of China's economic organization is a tribute. Of even greater importance is his good judgment in keeping his study simple and general in character. The temptation to undertake a more profound treatment than the basic facts would support he has disdained: thus his findings can be taken as reliable. Mr. Condliffe's long association with the economic facts of China and with the sources from which these facts are obtained—he served for several years as Research Secretary of the Institute of Pacific Relations—has given him unusual qualifications for the task.

Mr. Condliffe devotes his first chapter to the Chinese people, their origin and early growth, their number, and their distribution. The familiar facts of overpopulation he says "constitute China's greatest, most fundamental and most pressing difficulty, and stand in the way of all schemes for the betterment of her economic life." He sees no hope for the solution of this problem by emigration either to other lands or to less thickly settled regions in China, for the annual increase is too great; and he has little hope that industrialization will draw a sufficient volume of rural workers into urban employment to give relief. He believes that the problem is too vast for remedial measures short of restrictions on numerical increase.

The agricultural resources of China, the division of ownership, and the agricultural standard of living are examined in Chapter 2. Mr. Condliffe believes that the outstanding fact of Chinese farming is its minute scale and laborious intensity. He estimates that the average holding for the whole of China is 3.6 acres, and for many densely populated provinces such as Chekiang, Szechwan, and Yunnan it lies between 1.0 and 1.3 acres. Thus the standard of living is so low that the death rate contains a constant "famine factor." Improved farming is China's best hope to assure better conditions on the land. But this can give no more than temporary relief unless something is done to prevent further increase of numbers from swallowing up increased production.

Agricultural reorganization, the growth of towns, and urban industry are treated in turn, and chapters are devoted to China's public finance and her banking and currency problems. The burden put on her economic system by an un-unified currency based on a fluctuating silver standard is pointed out as a compelling reason for banking and currency reform which should be undertaken simultaneously with the balancing of the government budget and the rehabilitation of China's finances.

The final chapter is devoted to China's foreign trade. Here a more reliable basis for examination is possible, owing to the statistical work of the Chinese Maritime

Customs service. Mr. Condliffe shows that the foreign trade of China is important not only on its own account but for other reasons. For instance, it has made possible the growth of her modern cities, particularly Shanghai; it has promoted a "commerce of ideas" that has influenced modernization both political and economic; it has provided the only means for securing capital goods necessary for the new techniques; and the revenues derived from it have recently made it a potent instrument for self-government.

While Mr. Condliffe is mindful of the distressing conditions in China today and sets forth the enormous problems that press for solution, he is hopeful that a way out will eventually be found. "The Chinese people themselves," he concludes, "must be the judge of what is and what is not the most urgent object of political policy. . . . From the strictly economic point of view, however, it seems obvious that wherever a modicum of settled government and security has been established even for a comparatively brief period prosperity has quickly followed."

WALTER H. MALLORY

ECONOMIC STRUCTURE OF CHINESE SOCIETY

K. A. WITTFOGEL. **Wirtschaft und Gesellschaft Chinas: Versuch der wissenschaftlichen Analyse einer grossen asiatischen Agrargesellschaft.** Erster Teil: **Produktivkräfte, Produktions- und Zirkulationsprozess.** xxiv and 767 pp.; maps, ills., diagr. (Schriften des Instituts für sozialforschung an der Universität Frankfurt a. M., Vol. 3, Part I.) C. L. Hirschfeld, Leipzig, 1931. M.30. 9 x 6 inches.

The older writers, in their accounts of Chinese society, stressed more especially its psychic and political aspects. It is only recently that careful investigation has been accorded to its economic structure. Of the latter, the present work is a comprehensive survey, carried out with great thoroughness. The author writes from the standpoint of the communist and seeks to apply the doctrines of Karl Marx.

From an exhaustive discussion of the historical development of the Chinese system of production he proceeds to a description of the processes employed in agriculture, animal husbandry (including pisciculture and sericulture), forestry, mining, manufacturing, women's work, and much else. In the same thorough and methodical way he deals with the transporting, marketing, and financing involved in these manifold operations.

It may be said at once that the descriptive portions of the book are commendable in a high degree. The accounts of the loess, of the irrigation system, of rice culture, and of the part played by forced and slave labor in Chinese economic development—to select but a few examples among many—are excellently done.

In his interpretations and conclusions the author, owing in part to his communistic bias, is somewhat subjective, to say the least. His treatment of the earlier periods is also not quite all that it might be in the light of our present knowledge. Questions regarding the nature of the Chinese racial complex and primitive culture must be decided by the anthropologist and the archeologist, not by the sinologist or the sociologist. The early Chinese records tell us almost nothing regarding the cultural life of very ancient times, for the sufficient reason that they were all written far too late. Excavations show that the prehistoric Chinese, so far as we yet know them, were not nomadic hunters and food gatherers as Wittfogel says (p. 11) but sedentary peasants, dwelling in permanent villages and depending mainly for their subsistence upon hoe culture and swine breeding.

In attempting to reconstruct the beginnings of Chinese civilization it is of the first importance to take into account the sources from which China obtained her food plants and domestic animals; for practically none of these are indigenous. On this subject, however, the book has little or nothing to say.

The author is naturally most interested in the sociological aspects of his investigation. His discussion of the Chinese village organization, for instance, is well worth reading. Regarding the proportion of agricultural land actually owned by the peasantry he says (p. 388): "After the state . . . had conceded in principle the freedom of private ownership, we see the Chinese peasant making a tough struggle for his small holdings. With what result? Syrski reported . . . 'Nearly half of the whole cultivated land was leased' so that, therefore, about 50 per cent of the cultivated soil continues to be owned by the peasants."

Accurate and detailed statistics for more than an infinitesimal part of the total area are as yet wholly lacking. Such information as we have, however, suggests that about one-third of the soil is permanently owned by those who till it and another third by absentee landlords, the so-called "local gentry," living for the most part in fortified towns and usually collecting their rents through agents. The remaining portion of the land fluctuates in ownership between these two classes; in bad years it is mortgaged to usurers or sold outright to the landlords by its peasant owners, who struggle to regain possession of it in happier times. There is no genuine communism among the Chinese agrarian classes themselves. In recent years there has been, particularly in the south, much killing of landlords and seizing of their lands; but these acts have assumed rather the nature of a *Jacquerie* than of an organized social revolution, save where they have been instigated and directed by radical agitators.

In general, our author has relied for his facts on the older authorities. He has not taken full advantage of the results of the latest investigations, including those now beginning to be conducted by Chinese students. It is only rarely, as for instance on pages 700 and the following, that he speaks of the fundamental changes now being wrought in the field he treats of. Thus the great quantities of cotton grown in southern Shansi were transported, less than a decade ago, by vast numbers of camels. These have now been entirely displaced by motor trucks, with far-reaching effects on the economic system of the region. Again, the old junk traffic of the upper Yangtze has within the past few years been almost wholly wiped out by steam, with ensuing ruin to thousands. Since, however, the present volume is designated "Erster Teil," it is possible that these and kindred aspects of the subject are to be discussed later.

The cuts interspersed through the text impart to it a pleasantly Chinese flavor and illustrate not inadequately the various processes described. The two maps on page 275 are taken from works published, the one in 1851, the other in 1877; they not only add little but are in some respects misleading. In general, it may be said that the book is an important one, well written, logically organized, and full of interesting information. It gives a graphic, accurate, and comprehensive account of economic conditions as they existed in China just before they began to feel the impact of the modern world civilization.

C. W. Bishop

Central Europe

Emmanuel De Martonne. **Europe Centrale, Part II: Suisse, Autriche, Hongrie, Tchécoslovaquie, Pologne, Roumanie.** Pp. 381–845; maps, diagrs., ills. (Géographie Universelle, Vol. 4.) Librairie Armand Colin, Paris, 1931. 120 fr. 11½ x 8 inches.

In a previous review the first part of this valuable work—dealing with Central Europe in general and Germany—has been discussed (*Geogr. Rev.*, Vol. 21, 1931, pp. 688–690). In the second part the six remaining countries of Central Europe are described. The book opens with a double-page map of Switzerland in color which shows clearly by hachures the topographic facies of the country. The first chapter deals with the character of the Swiss population and includes maps dealing with

the history, language, and the three natural regions. The next chapter discusses the structure of the Alps, illustrated by means of Staub's sections. Charming photographs make the reader *au fait* with the chalets, glacial lakes and troughs, hanging valleys, and postglacial gorges. An interesting map shows the tourist traffic in the various centers. The Swiss "hill country" which extends from Geneva to Constance is next described. One is glad that De Martonne has not used the common term "Swiss Plateau" for what is tectonically a downwarp. Then comes a chapter on the Swiss Juras, and finally one on the economic life of Switzerland. Geographers will appreciate the up-to-date maps showing the power stations and railway traffic. Many readers will be surprised at the outstanding importance of the line joining Basel to Winterthur and the relative insignificance of the Simplon route.

The next four chapters are devoted to Austria, the same procedure being adopted. The new Austria has gained a real national unity, since now barely five per cent of the population belong to other nationalities. A notable map of the structure of the Tauern shows how closely the main lines of communication are controlled by the geology of the Crystalline Alps. There are many readers like the reviewer who will be delighted by the graphic diagrams that link "build" and settlement. Among these one may mention the epigenic gorge of the Danube above Vienna, the environs of Prague, and the Moravian karst.

While Hungary and Czechoslovakia are not very different in area, it is interesting to see that the somewhat monotonous plains of Hungary are dismissed with twenty pages, while the diversified land of Czechoslovakia is given nearly one hundred. For instance, there are no less than seven maps showing the rich and varied resources of Czechoslovakia. In the latter half of the book the author deals with Poland and Rumania in eleven masterly chapters. Here is collected a vast body of well arranged information, which is based on research in many cases not readily available to western Europeans. A novel map deals with the ethnology of Poland. We learn that the bulk of the people are pre-Slav and apparently akin to the Mediterranean in race. Only in the extreme northwest and east are there fairly pure Nordics. Special maps illustrate the Cretaceous "platforms" bordering the Carpathians between Łódź and Tarnopol. The discussion of the ancient ice-front valleys in the Great Plain, emphasizing their importance to the present population, is also most interesting. Several pages are devoted to Warsaw, and a large map is given to illustrate its growth from a primitive nucleus on the Vistula.

The last section deals with Rumania, on which the author has previously published many valuable studies. He points out that the modern state, like Gaul, may be divided into three parts. Transylvania is truly central European, the plains of the northeast look to Russia and the Orient, while the isolated hilly Dobrugea is structurally Balkan. Of the total population of eighteen millions, a third are foreigners. This third includes nearly two million Magyars and nearly one million Germans. Ruthenians and Bulgars total half a million each. A double-page plate in color shows the diversity of nationalities between Bremen and the Black Sea. Moreover, by an ingenious overprinting in black the percentages of the mixed groups are clearly shown. The build of the Carpathians is illustrated in many maps; but one would have liked to see a block diagram of the remarkable subsidences and antecedent valleys that transect the southern Carpathians.

The last chapter summarizes the controls exercised by the environment upon the development of the nations of Central Europe. Such factors as the "Hercynian zone" of ancient rocks, the Ice Ages, the folk-way of the Danube, and the ancient forests are discussed. For instance, the author contrasts the fully organized and developed area of the Rhineland with the sparsely populated, backward districts in Bessarabia. In his opinion a "smoothing" of the steep and irregular economic gradients between northwestern and southeastern Europe is essential to ensure the welfare of the central nations.

Study of this splendid text confirms the reviewer in his opinion that any complicated regional discussion must be based on an adequate presentation of the major geological units. Only when this structural geography is understood is the field clear for the study of the economic and human aspects of the problem.

GRIFFITH TAYLOR

SOUTHERN EUROPE

MARION I. NEWBIGIN. **Southern Europe: A Regional and Economic Geography of the Mediterranean Lands (Italy, Spain, Portugal, Greece, Albania, and Switzerland).** xvii and 428 pp.; maps, diagrs., bibliogrs., index. Methuen & Co., London, 1932. 15s. 9 x 6¼ inches.

E. H. CARRIER. **Water and Grass: A Study in the Pastoral Economy of Southern Europe.** xi and 434 pp.; maps, diagrs., bibliogr., index. Christophers, London, Melbourne, etc., 1932. 21s. 8¾ x 6 inches.

In all the wide range of her geographical writings it is evident that Miss Newbigin has a special regard for the "sunlit lands" of the Mediterranean, and a feeling of this charm comes through the somewhat formidable pages of her latest book. For, as the author says in a preface, which itself serves in part as review, this is a textbook for the serious student. She is at pains to correct oversimplified statements in current circulation and insists on the complexity of the geography of her area, alike in the physical bases and in the economic and social conditions in these lands of ancient heritage. This is the introduction to Switzerland, "land of anomalies," so well known and so elusive to the stranger: the playground of Europe "has not, despite the common belief to the contrary, easily grasped and purely 'natural' boundaries; cannot, except in the roughest fashion, be divided into satisfactory natural regions, and generally tends to escape from any simple framework on which a brief description might be based . . . The absence of unity which represents part of the price Switzerland has paid for its success in establishing . . . a non-national though eminently stable state. . . . Yet it would be unjust to regard the country as merely the great *carrefour* of Europe, for love of the mountains and of liberty, closely linked in the consciousness of the people, does serve as a unifying influence. If it is untrue to say that the Swiss are mainly hardy mountain peasants, wringing a spare livelihood from the reluctant soil, it is yet true that the mountains, with their pure air, their glistening snows, and their brilliant flowers, are never far below the horizon even of the townsfolk."

In contrast is the Iberian peninsula, aloof, marginal to Europe as a whole, a miniature continent with continentality marked as regards climatic conditions and their effects. The barrier of the Pyrenees is compared with the Alps: "effective lines of communication, like the waterlines on which they are so often based, depend less upon the actual physical obstacles to be overcome than upon the force of the current along them." "Africa begins at the Pyrenees" is an epigram of doubtful validity, whether from the viewpoint of physical structure or human history. New tectonic theories (throughout the volume the recent work in the physical history of the region is taken into account) find in Spain Asiatic as distinct from African analogies. "Southern Spain and the Atlas lands in reality turn their backs on each other," and the failure of Spanish efforts in Morocco is cited.

Ideas and information are here in full measure to reward close reading.

Miss Carrier's book, dealing with a special phase of Mediterranean life, also represents the result of a painstaking labor undertaken *con amore*. The author is known for her earlier volume "The Thirsty Earth" (1928), a study of the water problem in arid lands. In the present volume the scene is transferred to a region where climate, primarily through summer drought, and relief have since ancient times encouraged a migratory pastoral industry. Conditions past and present are examined for each

country of southern Europe in turn beginning with "Italy and that Rome to which most of the other lands were 'barbarian,' . . . the Castilian Mesta, whose pastoral activities were one consequence of an alien domination. Provence, which received both merino sheep and customs from Spain; the Balkans, with their wide-spread nomadic populations and characteristic features drawn in part from their link with the glorious past of the Aegean, and in part from their present isolation from the more socializing tendencies of Western Europe; the Pyrenean World, with its extraordinary self-sufficiency." Thereby broad differences as well as similarities are brought out, for instance the importance of historical circumstance in Italy as compared with more purely geographical influences in Provence. That the ancient practice of transhumance is not simply a stage in transition from absolute nomadism to absolute fixation but exists in its own right, as it were, is one of the theses of the book. It is upheld by the fact that, although transformed and reduced, transhumance seems to be permanently established in such a region as the Rhone delta where it flourishes along with agriculture to the mutual benefit. The flocks of Provence still number some quarter of a million head; and, though the "historic carraires [sheepways] have disappeared, and the sheep, like the tourists, may set off for their summer holiday in a railway train," the annual migration is still made to the Alpine pastures.

A Geographical Text on France

Hilda Ormsby. **France: A Regional and Economic Geography.** xiv and 515 pp.; maps, diagrs., bibliogr., index. E. P. Dutton and Co., New York, 1931. $6.50. 8¾ x 5¾ inches.

It is an interesting experience for a Frenchman to read a geographical treatise on France written by a foreigner: and an agreeable experience to find it not only a substantial work but one conceived in a spirit closely akin to that which the French school of geography considers its own.

Mrs. Ormsby's book is divided into three parts. The first, serving as an introduction, explains the unity of France in short order, for 16 of its 25 pages are devoted to climatic conditions. The author's distinction of climatic divisions is in fact needlessly elaborate—two only are of major importance, Atlantic and Mediterranean. But we will not cavil over this matter, for the essence of the book is in the second part and not in the preliminary pages.

Ten natural regions are recognized, and with slight variations they are those commonly recognized. The rather too systematic formula of the author by which "description and analysis is generally based on the river-basins" leads, however, to some incongruities. Périgord and the Causses of Quercy should not be studied with the Central Massif but with Aquitaine; Roussillon is unquestionably a part of the Mediterranean region, and Picardy a part of the Paris Basin. The Jura should be treated as a unit in itself, and surely it is not good geography to separate the basin of the Doubs from that of the Ain. It is gratifying to have the regional method thus wholeheartedly adopted, but the regions are still treated from the descriptive rather than the explanatory standpoint. A natural region often has no connection with a river basin, at least in France.

These criticisms apart, due credit must be given to the author. The bibliography is full and includes most of the important references; some of mediocre value might have been omitted. The regions that Mrs. Ormsby has evidently visited she has seen with the eye of a geographer; her accounts are precise, informed, and touched with life. But there are exceptions and, as it happens, in those regions with which I am best acquainted. The chapter on the French Alps cannot be counted satisfactory. How can one study this massif basin by basin, the Arve before the Isère, the Isère before the Drôme, without failing entirely to convey the harmonious arrangement of the alpine regions? And in the Mediterranean region, Corsica

is not less unfortunate: it is not a happy idea to compare this island to the Central Massif; while the comparison between "the small karstic plateau of Bastia" and the Causses of Rodez is an extraordinary flight of the imagination.

The last hundred pages of the book are devoted to economic geography—agriculture, industry, communications. This is carefully done and, aside from the small slips that are inevitable in such enumerations, gives a faithful picture of the economic activity of post-war France.

In sum, the book is an interesting and substantial contribution, inspired by a truly geographical method. That it has not succeeded completely is due to certain superannuated ideas which negative the regional conception. One must nevertheless thank the author for having produced on a foreign country so full, careful, and impartial a study.

RAOUL BLANCHARD

A Region of the French Alps

JULES BLACHE. **Les Massifs de la Grande-Chartreuse et du Vercors: Étude Géographique.** Vol. 1, **Géographie physique,** ix and 477 pp.; maps, diagrs., ills., bibliogr., index; Vol. 2, **Géographie humaine,** x and 514 pp.; maps, diagrs., ills., bibliogr., index. Didier et Richard, Grenoble, 1931. 120 frs. for the two volumes. 10 x 6¾ inches.

Once again we have been given a magnificent study of a portion of the French Alps, comparable to the excellent "L'Oisans" by André Allix. This work by Jules Blache is a complete geographical analysis of two massifs that lie at the gates of Grenoble. Three features stand out: scholarly restraint, thoroughness, and a clear-cut geographical philosophy. The restraint is shown, for example, in the analysis of climatological phenomena and in the giving there of just credit to geological and economic factors in determining the ecology. As to thoroughness, it is enough to say that the 991 pages are devoted to the study of but 1016 square kilometers. The thoroughness is almost too great for the average geographical reader. It is hoped that we may now have articles from the author making his information available in a more condensed and selected form. At such time the lack of topographic maps and altitude data should be remedied. It is difficult for one not familiar with the area to keep in mind the altitude relationship, so important to a complete understanding.

The work deserves high praise, but especially is it noteworthy for the manner in which the physical geography, though given a thorough treatment, is developed particularly for the purpose of explaining life responses. The section on forest ecology is a happy example of the explanatory use of physical conditions.

RODERICK PEATTIE

Wheat Climates of the Earth

GIROLAMO AZZI. **Le climat du blé dans le monde: Les bases écologiques de la culture mondiale du blé.** 1165 pp.; maps, ill. Institut International d'Agriculture, Rome, 1930. L. 200. 9¼ x 6¾ inches.

The material contained in this book by the indefatigable professor of agricultural ecology at the Istituto Superiore Agraria, Perugia, was assembled by correspondence between 1919 and 1925 and presented as a report to the International Conference on Wheat, meeting at Rome in April, 1927. The greater part of the volume is occupied by regional reports, which are carried in somewhat imperfect solution by the author's introductory and concluding chapters and by his effort toward as uniform an arrangement of the data as could be attained in working with material of extremely varied provenance and detail. Primary data collected by questionnaire and supplemented from miscellaneous literature cannot be expected to yield perfectly satisfactory discussions of all parts of the earth; but there can be no doubt

that the volume presents the fullest documentation available of the vicissitudes encountered by the wheat plant through its extremely wide range of cultivation. Attention is appropriately directed toward these vicissitudes, for the "climate" of a plant, in the author's usage, is of significance as a hampering and limiting agent, both directly and as conditioning the incidence of damage by noxious insects, fungous diseases, and the lodging of ripening grain.

From the author's point of view the unmodified term "climate" is worthless. Quantitative measurements of the climatic elements must be studied "as functions of the development and yield of the several crop plants"; hence the expressions "wheat climate," "olive climate," and the like. These terms signify in practice such presentations of climatic data as relate the data to physiologic processes of the plants that express themselves ultimately as crop yield. "Yield" is used in its most inclusive sense, comprising quality and reproductive capacity as well as quantity of product.

The problem posed is the familiar one of all ecologic studies but one demanding a more complete and drastic solution than those to which many commendable investigations have aspired. Physiologic research—in the present connection the work of H. Lundegårdh and of H. Walter comes to mind—is slowly unraveling the Gordian knot of ecologic relations, which the dull ax of the correlation coefficient has hacked partly asunder. Azzi's tool is much keener than the latter; to drop the metaphor, his method is ingenious and suggestive of application to a field wider than his specialty. It consists, essentially, in the grouping of climatic observations according to a phenologic, instead of the inflexible civil, calendar. Certain "critical phases" in the life of the plant are recognized, which mark the formation or disappearance of organs. These critical phases divide the cycle into "sub-periods," during which the requirements of the plant do not change. The annual cycle of winter wheat in the Mediterranean region, for example, is separated into the following sub-periods:

1. Autumn: germination and development of the plant until the beginning of tillering.
2. Winter: from the beginning of tillering until its completion.
3. Spring: from the completion of tillering until heading.
4. Summer: from heading until harvest.

For each sub-period, phenologic and climatologic observations provide the data basic to a table of maxima and minima of the climatic elements, between which the crop plant produces a yield economically profitable. Once the limits of any variety are discovered, climatic data from any region can be compared with this norm. Instead of means of a period of years, frequencies of occurrence of limiting maxima and minima are used. The limiting factor may be a single element during one critical phase. In Italy, the critical factor in the yield of wheat is rainfall during the month preceding heading. The significant climatic element is therefore the frequency of deficient precipitation (less than 40 mm.) during this period, the place of which in the civil calendar varies by about 50 days between the northernmost and the southernmost parts of the realm.

The maxima and minima used are not those that determine the growth or reproduction of the crop plant. Rather, they are the frequencies of excess or deficiency that mark the boundaries between areas of profitable and unprofitable cultivation. The concepts, maximum and minimum, are thus flexible, involving economic as well as physical considerations. Poleward and other regional limits of cultivation are only in part climatic and may fluctuate not only with the sequence of climatic variations but also with economic changes. Attempts to correlate limits of cultivation with certain isotherms or isohyets are therefore vain.

The conceptual structure sketched in the foregoing is based on the author's investigations of several crop plants. The program of investigation is an admirable compromise between the physiologic approach and the frequently almost blind quest

after correlations within the civil calendar. Azzi's theoretic and bibliographic background may be examined much better in his "Ecologia agraria" (Nuova enciclopedia agraria italiana, Torino, 1928) than in the present monograph. There the phenologic subdivision of the annual cycle is applied to fruit trees, spring grains, cotton, the potato, the olive, and harmful insects, and the methodology of investigation based upon it presented in detail.

The examination of the wheat climates of the earth leads to certain summaries, which are put into cartographic form. The world maps that show by isophanes the dates of seeding and harvest are fundamental phenologic material. On maps of varying scale and detail, regions characterized by the dominance of certain limiting factors are distinguished. These "physiographic regions" are named according to the nature of the respective adverse factors: "dry-cold," "dry," "humid-cold," "cold," etc. On the maps of larger scale, transitions and subordinate factors are recognized. A final summary map of the earth presents important distinctions: regions of excess or deficiency of moisture and temperature; the equatorial limit in the northern hemisphere of adverse effects of the cold season (to be compared with the *C–D* climatic boundary in Köppen's classification); and degrees of intensity of drought as affecting the production of wheat. JOHN B. LEIGHLY

RUSSIA AND WHEAT

VLADIMIR P. TIMOSHENKO. **Agricultural Russia and the Wheat Problem.** xi and 571 pp.; maps, diagrs., index. (Grain Economics Ser., No. 1, September, 1932.) Published jointly by the Food Research Institute and the Committee on Russian Research of the Hoover War Library, Stanford University, California, 1932. $4.00. 9 x 6 inches.

Russia as a Producer and Exporter of Wheat. Maps, diagrs. *Wheat Studies of the Food Research Institute*, Stanford University, Cal., Vol. 8, 1932, pp. 277–375.

"Agricultural Russia and the Wheat Problem" by V. P. Timoshenko of the University of Michigan, which is summarized in full in the bulletin of the Food Research Institute, is mainly historical and statistical. The author gives actual numerical data in place of the general information familiar to those who have given some attention to Soviet Russia. Parts of the discussion, however, go much deeper into the subject than most writers on present-day Russia. His discussion of the population of Russia, its high rate of increase, and the rural overpopulation of part of European Russia is highly instructive. His discussion also of the high per capita bread consumption and the possible change that may take place in this respect in the future is suggestive as to its possible effect on wheat for export.

The author deals quite fully with land tenure; the agrarian revolution; Soviet agricultural policy, concerned mainly with the familiar collectivization and state farms; the history of Russian agricultural production, well illustrated with statistical tables and graphs; agricultural organization and practice, dealing with the use of machinery before the war; cultivation of the bread grains; disposition of crops; markets and exports. A short chapter is devoted to a forecast or outlook. This is conservatively stated, based on statistical data and actual performance in the past with little reference to possibilities. The whole series of conditions so often and persistently catalogued in American discussions of Russia's future are given due attention. These include the standard American unwillingness to admit that the Russian peasant can learn to use agricultural machinery, doubt as to the possibility of producing a sufficient tractor supply, the absence of draft animals, the poor conditions of Russia's transportation systems and many others, with all of which Americans are familiar. He does not mention, however, the almost inevitable influence on wheat production and export of the great drop in world wheat prices

within the last two years and the strong drift toward embargoes on Russian wheat in most consuming countries.

The opinions based on statistics, the data familiar to the author, seem to be justified. Some opinions on the possibility of an expansion of cultivated area, however, must be questioned. In his discussion of land utilization and the outlook for expansion of crop area, the author states, after disposing of the *taiga*, which has no value whatever for wheat production, that the two-thirds to three-fourths of the area of Siberia lying south of the *taiga* zone remaining unoccupied will have to be deforested and drained. This is the region, especially that part not now cultivated, that is dry grassland. Whatever plans the Soviet authorities may have for draining and deforesting land north of the Siberian railway, where they may contemplate the growth of other crops than wheat, their plans for extension of wheat culture in Siberia do not contemplate either operation. The region already explored in part and considered by competent authorities as wheatland of high quality is neither forest land nor wet land. Neither is it a region in which it is planned to attempt colonization. It is the region in which giant wheat farms are to be developed. This statement, in so far as it concerns available free high-class wheatland in this region, is based on definite statements made to the reviewer by Tulaikoff of the Saratov Station, who has been directing exploration in this region. The author presents no facts capable, as the reviewer sees it, of controverting Tulaikoff's statement. The reviewer agrees that the development of great grain farms in this region is conditioned on the building of railways. This is not an insurmountable task, however. The author's statement that the Russian plan for larger farm development concerns the region of gray desert soils south of latitude 50° is true only to a slight extent. The plan contemplates the use of black earth or semi-black earth rather than desert. It is only in part, therefore, and apparently a minor part, that the Soviet plans contemplate the use, for large wheat farms, of "lands of inferior quality."

On the whole, the author's opinion that a great increase in the production of wheat within the next few years should not be expected, seems to be justified. From the point of view of the economic development of the world, it is wholly an irrelevant and unimportant matter whether such development take place during the first, second, or third five-year plan. World conditions do not now favor an increase in wheat production anywhere.

Nothing in Professor Timoshenko's studies shows that in inherent natural capacity the territory included in the Soviet Union is not capable of increasing very greatly its wheat production. Whether it be done or not is a matter depending on other conditions than those of character and availability of land. As long as the author's opinions are expressed as an economist and are based on the traditional data used by the economist, statistics, they seem to be sound. As soon, however, as he assumes the rôle of the geographer he shows his unfamiliarity with the material he is dealing with and his opinions are less convincing.

C. F. MARBUT

THE WHEAT BELT OF THE UNITED STATES

WERNER LUDEWIG. **Die Anbauzonen des Weizens in den Vereinigten Staaten und die Methodik ihrer kartenmässigen Darstellung.** 103 pp.; maps, bibliogr. *Berichte über Landwirtschaft*, Suppl. No. 53 (N. S.), 1932.

The United States stands unique among the countries of the world in its inherent capacity not only for agricultural specialization in its great corn, cotton, wheat, and subtropical products belts but also in its capacity for wide diversification of agriculture in the great mid-latitudes belt of country. Both characteristics have been strikingly brought out in Doctor Ludewig's book, a study well worth the attention of students of crop geography.

After a brief statistical review of the production and export of wheat, he traces

the progress across the country of a great wave of wheat production, advancing with settlement, and leaving behind as it slowly rolled across country a number of permanent zones of wheat production in localities where natural conditions are favorable. The author's unfamiliarity with the fundamental differences in the great soil zones of the United States leads him, however, into some explanations of doubtful validity.

The history of wheat production in each of the geographic regions of the United States is outlined after a brief account of the meteorological conditions in the country. The natural vegetation as an environmental factor is referred to, but the author fails to recognize that its significance is representative or suggestive rather than directly active, being a passive *expression* of climate on the one hand and *mediately active* through its effect in developing soil character on the other. His conclusion is that "From the standpoint of natural condition the great area of cultivated land in two great regional belts of the United States, stretching, the first one, from Pennsylvania to Washington and the other, from Texas to North Dakota, are adapted to the growth of wheat, very often especially fitted for it." His maps and text, however, show that in certain localities only, even within these belts, is wheat production important. The explanation, which he does not make clear enough, lies in wide soil differences within regions where other conditions are highly favorable. Even when wheat has been replaced by other grain crops such as corn and oats, soil conditions rather than economic ones have usually been the dominant factor.

Of the series of maps prepared showing graphically the results of this investigation by periods only three, for lack of funds, are included. The method devised for the purpose gives total production per county unit by means of dots and percentage of total cultivated land within the same unit area occupied by wheat by a color scheme that brings out both density of production and density of acreage.

The zones at each period are well brought out; those east of the Great Plains are the permanent zones left behind on favorable spots by the great wandering pioneer belt zone that swept across the country during settlement. West of the eastern Great Plains boundary the author is in some cases inclined to think the zones are still progressing. To the American student the possibility of future movement seems very small.

C. F. MARBUT

COTTON MANUFACTURING IN NEW ENGLAND

J. HERBERT BURGY. **The New England Cotton Textile Industry: A Study in Industrial Geography.** vii and 246 pp.; maps, diagrs., index. Baltimore, 1932. $4.50. 9¼ x 6 inches.

Dr. Burgy's primary interest is in the geographical aspects of cotton manufacturing in New England. He includes a suggestive chapter on localization within the region. From its beginnings in the early years of the nineteenth century the making of cotton textiles has followed distinctive lines of development in the several outstanding centers of manufacture. The first home of the industry—the Blackstone Valley and the neighboring part of Rhode Island and eastern Connecticut—is characterized by many small, scattered water powers. "But few of the communities had sufficient power to serve more than one or two mills." This accounts, in part at least, for the rise of numerous small establishments that have put out on the whole a diversified product of fine quality. On the other hand, the Merrimac Valley, where water power is more concentrated, has tended to become an area of large mills and of mass production. These differences have persisted, even though steam has largely superseded water power in both localities. Under "present competitive conditions brought about by the increased production of coarse goods in the Southern

States," the diversified mills of the Rhode Island-Connecticut area would seem to be in a better position than the larger establishments of the Merrimac Valley.

Dr. Burgy describes the topography and climate of Fall River and New Bedford in relation to cotton manufacture. He considers New England's power resources, the geography of the raw materials, the routes by which raw materials are transported to the mills, the favored location of New England in relation to the greatest textile market of the nation—New York. In the early days of the industry geographical factors played a more obviously important part than they do today. Now economic considerations take the first place in every serious discussion of the destiny of New England's textiles. The troublesome questions are those of labor costs and labor efficiency, taxation, ownership, management, and distribution. Dr. Burgy summarizes these problems. His conclusions do not differ essentially from the published conclusions of a good many others who have studied the situation critically. He thinks that New England's chances of regaining its former "leadership in national cotton manufacturing . . . are slight," but that the manufacture of cotton textiles will undoubtedly "always have an important place in the industrial structure of the region." He believes there is need for "an increased output and superior quality of product per operative" and for "a greater community consciousness and coöperative attitude in many New England mill villages and centers." These familiar formulae, however, carry us just so far and no farther. Greater efficiency and increased productivity in particular lines of industry will not suffice to solve the major industrial problems of New England—or of any other section of the country. Their solution lies in realms of economic and social thought and leadership beyond the scope of Dr. Burgy's thesis.

British Honduras and British Guiana

Sir John Alder Burdon, edit. **Archives of British Honduras.** Vol. I, **From the earliest date to A. D. 1800, Being Extracts and Précis from Records, with Maps.** xv and 304 pp.; maps, index. Published by Authority of the Governor in Council on behalf of the West India Committee by Sifton Praed & Co., London, 1931. 7s. 6d. 8¾ x 5¾ inches.

In his introduction to "Archives of British Honduras" Professor A. P. Newton aptly compares the isolated possessions of British Guiana and British Honduras to "chips split off in the carving of the great masses of rival empires," tossed aside and forgotten. Thanks are due to Sir John Burdon for recreating the history of the latter colony, of which he was governor. The archival material is presented in chronological order beginning with 1587, mostly in the form of précis and extract but with the most important documents printed *in extenso*. Continuity is given the material by a preliminary historical note by the editor setting forth the long struggle between "Baymen" and Spaniards over this settlement which "owed its origin and retention solely to logwood," till the latter years of the eighteenth century saw the colony established on a sure basis. Geographically one of the most interesting features is the reproduction of a map of 1787 whose title runs "A Map of a Part of Yucatan or of that Part of the Eastern Shore within the Bay of Honduras Alloted to Great Britain for the Cutting of Logwood, in consequence of the Convention Signed with Spain on the 14th July 1786, By a Bay-Man." The main map is on a scale of 6 miles to an inch and has an inset, "Mosquitia" by William Faden.

The preparation of the archives has been most carefully and painstakingly done. A brief chronology sums up the matter, and a list of records defines the sources. Local records are few in number, reflecting the precariousness of existence in the early period of settlement, a precariousness still felt as far as natural causes are concerned. The second and third volumes of the archives bringing the history of the colony down to 1884 are completed, but owing to the disastrous hurricane of

1931 funds are lacking for publication—a misfortune which scholars will hope may soon be repaired.

A. R. F. Webber. **Centenary History and Handbook of British Guiana.** With appendix by H. P. Christiani and six water colors by R. G. Sharples. viii, 363, and xxxiv pp.; ills. "The Argosy" Co., Ltd., British Guiana, 1931. $1.50. 8¼ x 5¾ inches.

The history of British Guiana is treated chronologically in four periods. The first, 1581–1831, is "the most difficult" span, the second, 1831–1851, marked by the freeing of the slaves, is "the most turbulent," the third, 1851–1891, is that in which the colony reached "the nadir of its industrial fortunes," in a "desolation perhaps unique in any British colonial province." The fourth period, 1891–1931, has seen immigration "reach its zenith and cease," the sugar industry exhibit "its glory as well as its greatest decline," gold and diamonds successively attain the peaks of their production, bauxite represent a new export and timber an increasing resource, while "cattle-rearing, on the coast lands as well as in the far interior, both for local consumption and export, has become a serious industry, warranting the Government in constructing a cattle trail 300 miles long to the far Brazilian border."

A New Geological Map of Australia

Sir T. W. Edgeworth David. **Explanatory Notes to Accompany a New Geological Map of the Commonwealth of Australia.** Based on the maps already published by the Geological Surveys of the various States, etc. 177 pp.; maps, diagrs.; map in four sheets in case. The Commonwealth Council for Scientific and Industrial Research, Sydney, 1932. 10 x 6½ inches; case 8¼ x 5¾ inches.

For many years Sir Edgeworth David has been engaged on a three-volume book on Australian geology. This is to be issued shortly; but meanwhile the main map in four sheets in color has been published, together with a most valuable summary. No map comparable with this has appeared before, though separate state maps have been issued for many of the better known parts of the continent. Moreover, in the present map the geological features of the British half of New Guinea are charted for the first time. Around the margins of the map, which is on the scale of 48 miles to the inch, are placed 11 typical cross sections of the continent. The whole publication is expressly designed to interest the traveler and the layman as well as the geologist. Hence much stress is laid on the economic aspects of the geology.

There are five sections in the explanatory "Notes," of which three are of direct interest to the geographer. Under "Physical Geology" the author shows the close relationship between topography and underlying structure. The continental mass has been relatively quiescent throughout the geological record; especially in the west, where Paleozoic sediments are still porous enough to contain artesian water. On the other hand, in New Guinea Miocene strata are found uplifted 16,000 feet above the sea. Much of the geology of the interior of the Commonwealth is of course hidden beneath sand dunes, and the area of these is indicated in a text figure. It is suggested that the dominant trade winds have always eroded the eastern parts and deposited material on the western areas, while earth tides have perhaps led to the strong development of meridional folds in most parts of Australia. The ranges in eastern Australia are probably largely due to the sinking of the heavy rocks of the floor of the adjacent southwest Pacific. Active volcanoes do not occur in Australia, though extinct cones are common in Victoria. However, submarine volcanic peaks 16,000 feet high have been discovered about one hundred miles east of Brisbane.

Australia is especially interesting to students of climatic change. Thus at the dawn of the Cambrian there were layers of glacial till which now form beds 1000 feet thick in the Flinders Range (S.A.). In early Permian times glaciation on almost

as large a scale occurred, so that all the southern half of the continent was under ice. In Lower Cretaceous times southeastern Australia was a gathering ground for ice whose relics cover much of central Australia. In Pleistocene times only small areas on the mainland near Mt. Kosciusko show cirque glaciation, but Tasmania was extensively glaciated.

The fourth part of the "Notes" deals with economic geology. Probably few realize that an area of nearly one million square miles in somewhat arid Australia covers artesian water. Interesting figures for the coal resources show that those near Sydney rival the supplies of Britain. The last section, a historical review, is a splendid account of the paleogeographical changes in a continent.

GRIFFITH TAYLOR

A NEW CARTOGRAPHICAL JOURNAL

Cartographical News, No. 1. *Bull. State Institute of Geodesy and Cartography at the Superior Geodetic Survey of the U. S. S. R.*, Leningrad, 1931.

The aims of this new journal are to provide maps of interesting regions, bibliographies and notices of cartographical publications, information about recent cartographical work in Russia, and a general review of foreign cartographical news. If the high standard of the first number of *Cartographical News* is maintained, the new publication will be most useful.

The contents of this number include an article by Schokalsky on the Kara Sea, an account by Wiese of the *Sedov* expedition to the Arctic in 1930, and a note on the cartographical work carried out by the Taz expedition in 1926–1927 by R. E. Kols. K. A. Salischev, in describing the "New Geography of the Kolyma-Indigirka Region," gives a detailed record, with bibliographical references for the many expeditions that have gradually thrown light on the geography of this difficult region. A preliminary map on the scale of 1 : 5,000,000, with relief shown in color, would alone make this issue worth while, for it incorporates the results of the recent (1926 onwards) expeditions. Comparison with current maps shows how mistaken have been the generally accepted views. In 1926 the Indigirka expedition of the Geological Committee, under the leadership of S. Obruchev and with K. A. Salischev to record astronomical points, discovered the Cherski range of mountains, one of the few remaining mountain systems unknown to the modern world; it consists of a great curve running parallel to the Verkhoyansk-Dzhugdzhur range and surpasses it in height. Since 1926 several route traverses have been made. Though the expeditions are so recent that no full survey of their results is as yet available, they show how much of the old orographical and hydrographical reconstruction of the region must be discarded. The main changes are in the Kolyma basin. The Kolyma itself is about 2500 kilometers long, one of the longest waterways in northern Asia. Instead of flowing directly northeast, as previously shown, it bends to the southeast for more than 400 kilometers. Thus the watershed between the Arctic and the Okhotsk seas is nearer to the latter than formerly thought, and the basin of the Kolyma is larger.

A short note, with a relief map, outlines the new Khakasskaya autonomous area, created in 1930, within the western Siberian area. Situated on the left bank of the Upper Yenisei, it occupies an area about twice as large as the Crimea; its administrative center is Abakan, just west of Minusinsk.

Perhaps the most interesting map is that by Professor Schokalsky of the Kara Sea. On it are marked in great detail the routes of the chief expeditions between 1871 and 1931, the positions of the radio stations for guiding navigation, and many other useful points. R. E. Kols gives a plan and a section of work carried out on the lower Taz. His full results were published in an "Atlas of the Lower Course of the Taz, 1930" and in "The River Taz: A Description of the Lower Course of the River from Khalmersed to Sidorov Harbor."

R. M. FLEMING

A Bibliography of Maps of Michigan

Louis C. Karpinski. **Bibliography of the Printed Maps of Michigan, 1804–1880, with a Series of Over One Hundred Reproductions of Maps; Constituting an Historical Atlas of the Great Lakes and Michigan.** Including Discussions of Michigan Maps and Map-Makers by William Lee Jenks. 539 pp.; maps, index. Michigan Historical Commission, Lansing, Mich., 1931. 9¼ x 6½ inches.

Louis C. Karpinski. **Historical Atlas of the Great Lakes and Michigan.** To accompany the Bibliography of the Printed Maps of Michigan. 104 pp. Michigan Historical Commission, Lansing, Mich., 1931. 9¼ x 12¾ inches.

On Gerard Mercator's map of the world of 1569 there appears in the far northern interior of North America a small, rounded "Mare dulce" communicating with Arctic waters. The first vague rumors of the Great Lakes brought back to Europe by Jacques Cartier were thus given cartographic form, and from this seed the intricate outlines of the lakes slowly unfolded with the progress of further exploration. On the maps of the succeeding fifty years or more the shapes of the lakes are scarcely recognizable, but after the mid-seventeenth century the contours become more familiar although still badly distorted. Not until well into the nineteenth century had precise geographical measurements advanced far enough to give the lakes their definitive outlines.

Professor Karpinski sketches this evolution in introductory chapters of the volume first listed above and illustrates it with half-tone and line reproductions that lend his work an interest beyond that of the usual bibliography. The book is, in fact, a cross section through the cartographic history of the United States. While the lists of printed maps of the period 1804–1880 occupy most of the space, there is included a useful summary of the fundamental maps of earlier times—both manuscript and printed—together with comments on such topics as school atlases and geographies, county and township maps, and a note by W. L. Jenks on the work of the Farmer family of Michigan, who for three generations were engaged in the map-making and publishing business. Among the vagaries of cartographers that long persisted were imaginary islands in Lake Superior and astonishing transformations in the shape of the lower Michigan peninsula. Some one apparently thought that there ought to be a high plain running down the middle of the lower peninsula, and accordingly William Delisle introduced such a plain on a map of 1718. Later cartographers even connected this plain with the Appalachian system. It did not finally disappear until the second half of the nineteenth century.

The bibliographical lists are very comprehensive. The enthusiasm of the collector has gone into their compilation. They comprise maps of the United States and Great Lakes area, 1804–1825; maps of the state of Michigan, 1822–1880 (the first state map was published in 1822); maps in school atlases and geographies; county atlases; maps of counties, towns, and cities; and various official and miscellaneous maps. Titles and imprints are quoted, dimensions are stated and usually the scales, and references are given to the leading libraries possessing copies of the items listed. The illustrations have also been published separately without commentary in the "Historical Atlas."

Professor Karpinski has done a very creditable piece of work for Michigan, and it is hoped that he may find imitators in other states.

Structural Problems of the Earth

J. A. Steers. **The Unstable Earth: Some Recent Views in Geomorphology.** xiii and 341 pp.; maps, diagrs., index. E. P. Dutton and Co., Inc., New York, 1932. 7¾ x 5¼ inches.

The subtitle of this book will probably suggest to the American mind a somewhat erroneous picture of its scope, for apparently the author understands by the term

"geomorphology" not only the form of the earth and its general surface configuration but also the internal composition and structure of the globe. Almost two-thirds of it is concerned with the major structural problems of the earth, such as the localization of continental masses, the permanence of ocean basins, and the origin of mountain ranges. The remaining one-third is devoted to the purely physiographic problems of raised beaches, river terraces, and coral reefs.

There is a good deal to be said in favor of introducing in the study of geomorphology a certain amount of broad structural matter, both fact and theory, because diastrophism has had much to do with the formation of physiographic features. For example, in considering the origin of recent raised beaches it is perfectly obvious that eustatic shift of ocean level may and doubtless does form a great part of the explanation. But it is equally true that the theory of isostatic adjustment of land and sea must play a part in the theory of eustatic shift, which presupposes the locking up of a large volume of water in the form of continental ice caps.

On the other hand, it is questionable whether the incorporation in this book of such theories as the thermal contraction theory of Jeffreys or the radioactive theory of Joly does not drag in relatively extraneous matter that merely befogs the issue, which the author states in his preface to be the evolution of continents and oceans and the oscillations in sea level in Recent times.

The book opens with a brief outline of the Tetrahedral theory of continental arrangement and then devotes the remainder of a long chapter to an analysis of the most important features of the earth's surface, discussing in turn the rigid masses, or shields, geosynclines, mountain systems, and oceans, ending with a brief consideration of island arcs and submarine canyons. The author writes in such readable style that a few lapses into grammatical obscurity are easily overlooked. But his subject matter is unwieldy, and the lengthy discussion of all the mountain-making periods of the geologic past could well be condensed and questionable statements omitted, such as Caledonian folding in Virginia and the southward extent of Taconian folding in North America.

The second chapter deals with the seismological evidence on the internal structure of the earth and with the theory of isostasy. The material is well presented in general, although the treatment of seismic waves is a bit hard to follow and might well have been simplified for the purpose in hand.

The chapter on the structure of mountain ranges seems somewhat out of place in its present environment and more suited, because of its extremely detailed nature, to a book on tectonics. Of course the connection between the internal structure of mountain ranges and their external form is extremely important to the physiographer. The surface expression of a fault-block structure is characteristically different from that of a range carved out of an acutely folded terrane. Therefore no apology is necessary for considering the general structure of the Alps. But the very detailed discussion of the structure of the West and the East Alps tempts one to say that the author, who is evidently much intrigued by the nappe theory, has not done full justice to the ideas of the East Alpine school. Certainly he has failed entirely to bring out the strong contrast between the recumbent folding and progressive metamorphism of sedimentary rocks in the Pennine nappes of the Western Alps and the imbricate structure, accompanied by the retrogressive metamorphism of a highly crystalline complex that has been described by geological workers in the Eastern Alps. However, the outward form of the Glarner Alps is the same regardless of whether the classic fold of Glarus be interpreted as a fan fold or as a nappe. As a tectonic discussion the author's section on the West and East Alps is inadequate; from the physiographic point of view it is superfluous.

The fourth chapter, which deals with recent theories, is one of the most interesting in the book and is such a readable presentation that wandering from the surface of the earth into its interior has really served a useful purpose.

The two chapters devoted specially to physiographic problems show a familiarity with the subject that is missing in the earlier part of the book. The raised beaches of the British Isles and Scandinavia and of western France and the Mediterranean are discussed at length. A curious error has transposed the levels of the Tyrrhenian and Milazzian beaches on several pages, so that the reader who is unfamiliar with the Mediterranean area will come away with considerable uncertainty as to whether the Tyrrhenian beach actually stands at an altitude of 35 or of 55–60 meters. The question of the origin of marine beaches in the so-called stable areas of Wright gives rise to an interesting discussion of the influence of interglacial climate upon sea level. While the author inclines to favor the eustatic origin of such terraces, he is justifiably guarded in the adoption of this explanation. The interrelation of eustatic shift and isostatic adjustment in the formation of terraces in such areas as Britain and Scandinavia is interestingly summarized.

The final subjects discussed in this book are coral reefs and islands, and here the author is at his best. He gives an interesting résumé of various theories for the origin of coral reefs and a comprehensive discussion of coral islands and of the Great Barrier Reef, about which he naturally speaks with authority as he was a member of the Great Barrier Reef Expedition of 1928–1929. He explains the reefs of the Great Barrier as resting on a series of blocks faulted down parallel to the coast line of Queensland, and thereby he modifies in an essential way the subsidence theory of Davis. On the other hand, he favors Davis' reorientation of the Darwin-Dana subsidence theory as the explanation of coral reefs in general.

ELEANORA BLISS KNOPF

GLACIAL PHENOMENA IN THE KARAKORAM

P. C. VISSER. **Gletscherüberschiebungen im Nubra- und Shyock-Gebiet des Karakorum.** Diagrs., ills. *Zeitschr. für Gletscherkunde*, Vol. 20, 1932, pp. 29–44.

This is a preliminary account of some glaciological phenomena seen during the Third Netherland Expedition to Central Asia, 1929–1930. It is concerned with the great pyramids of white ice that rise from the moraine-covered surface of certain Karakoram glaciers and with the suggested overthrusts of some glaciers upon others.

These ice pyramids, which may be scores of feet in height, have been described by earlier explorers; but they have not been satisfactorily explained. Visser notes that the ice of the pyramids is névé ice, whereas the ice of the underlying glacier consists of glacier grains. From this and other observations, including the disposition of the pyramids, Visser concludes that they are made up of névé poured down by avalanches from the steep walls of the valley upon the moraine-covered dissipator of the main glacier or are due to the overthrust of a steep lateral tributary upon the main glacier. The peculiar pyramidal form is probably accounted for by ablation in a dry region, for Visser tells us that the pyramids are not general but occur only on certain glaciers of the dry zone on the northern side of the Karakoram. Visser's explanation seems quite satisfactory; although, in contrast to him, I am inclined to emphasize avalanches as the source of the overlying ice rather than overthrusts. It is unfortunate that he did not cut a trench or short tunnel into the base of one of the pyramids, for this would have disclosed definitely the relation between the pyramids, the moraine, and the underlying ice.

Visser's idea that some glaciers are overthrust upon others is open to more controversy. He realizes that nothing of this kind has been recognized in the Alps but thinks that the ice may behave differently in other regions and under other conditions. The most extreme case mentioned by him is of four glaciers lying one upon another and separated by sheets of moraine; he thinks that, at least to a large extent, their movements are independent. The force that causes the ice to move down the

valley is the weight of the ice itself, and it is difficult to understand how the presence of a sheet of moraine within the body of the ice could materially modify this force. Visser bases his views on the forms of the moraines and differences in the structure of the ice. My own experience with glaciers has made me skeptical of appearances, which are often deceptive. There is a small glacier on a mountain bordering the Forno Glacier in the Engadine that corresponds strikingly with Visser's description of an overthrust glacier, and long and careful observations were required to prove that it was the result of snow avalanches upon the dissipator of another glacier. A crevasse, which cut through the overlying and the underlying ice and the moraine separating them, was not offset, showing that the whole acted as a unit and that the parts did not have independent motions.

Visser has presented an interesting problem to glacialists: Are there great overthrusts of the ice of glaciers of the same nature as the overthrusts of the rock of the earth's crust? Or, can the phenomena he describes be due to avalanches falling upon the dissipator of a large glacier?

HARRY FIELDING REID

FOUR REGIONS FROM THE "HANDBUCH DER KLIMATOLOGIE"

B. J. BIRKELAND AND N. J. FÖYN. **Klima von Nordwesteuropa und den Inseln von Island bis Franz-Josef-Land.** 124 pp.; maps, bibliogr. (Handbuch der Klimatologie, Vol. 3, Part L.) Gebrüder Borntraeger, Berlin, 1932. 10½ x 7 inches.

E. ALT. **Klimakunde von Mittel- und Südeuropa.** iv and 288 pp.; maps, bibliogr. (*Ibid.*, Part M.) 1932.

Australien und Neuseeland. I. **Climatology of Australia** by Griffith Taylor; II. **Climatology of New Zealand** by E. Kidson. vii and 138 pp.; maps, bibliogr. (*Ibid.*, Vol. 4, Part S.) 1932.

C. BRAAK. **Klimakunde von Hinterindien und Insulinde.** 125 pp.; maps, bibliogr. (*Ibid.*, Part R.) 1931.

It is quite unnecessary to say how welcome is the appearance of each successive installment of this indispensable handbook. Take the convenience of the tables alone. In Parts L and M, which together cover Europe with the exception of Russia, there are climatic tables for 521 stations with maps identifying the stations (169 for the Northwest, 352 for Southern and Central Europe).

In Part L, Northwestern Europe, some 17 pages are devoted to a general discussion of the climate of the region, with the aid of 22 maps. Most interesting of the maps is the temperature anomaly for January, showing for the Lofoten Islands the high anomaly of 28° C., perhaps the highest in the world. Description of the individual climatic regions, eleven in number, follows, beginning with Jan Mayen. We learn that the island has rarely been closed by drift ice since a Norwegian weather station was set up there in 1921. It is also noted that the years from 1919 to 1930 have been specially ice-free in a record of 135 years from Iceland. For Spitsbergen is included a table of temperatures summarizing data gathered by expeditions at nine stations, the warmest of which is Storö with a February minimum of −15.4 and a sea usually ice-free.

In Part M, Central and Southern Europe, a substantial section of 100 pages, illustrated with 65 maps, takes up the climatic elements *seriatim*. The 65 maps afford valuable illustration: precipitation, for instance, is represented by maps showing seasons of maximum and minimum rainfall, rainfall amplitude, rainfall variability, number of rainy days in January, July, and for the year, distribution of precipitation in selected months, number of days of snowfall. Short descriptions of climate by countries follow.

Professor Taylor's contribution on the climatology of Australia is unique in that

it interprets the climatological data in geographical terms. His interpretations are so widely known that it will suffice here to say that the presentation has been very well done. Every paragraph is of geographical interest. This is the one on distribution of rain gauges:

"There are about 6000 stations in Australia which are arranged in accord with the importance of the rainfall data. Thus in the wheat belt in the southeast the gauges are approximately 16 kilometres apart. In the sparse pastoral areas they are more than 60 kilometres apart. Since every large sheep or cattle station has a rain gauge the map of their distribution is a fairly good indication of settlement in Australia, for where there are no rain gauges there are no settlers."

Special praise is due to the terse account of the sixteen major climatic regions. The usual relation of the area in question to the Köppen classification is by Köppen himself. It introduces certain changes in the boundaries of the climatic provinces as they are delineated on the Köppen-Geiger map of 1928. (These new boundaries are shown in Fig. 3, p. 111, of this *Review*.)

The short but clear and informative discussion of the climatology of New Zealand by Dr. Kidson includes reference to Macquarie Island.

In New Guinea Professor Taylor's contribution touches that of Dr. Braak, who covers Indo-China, Siam, Tenasserim (Burma), the Philippines, and the "equatorial portion of the Asiatic-Australian Monsoon region." We note particularly the rainfall maps for selected months for the area as a whole and for Java separately. The latter bring out well the local diversities in this island and mountain world. Asembagus at the eastern end of Java has an annual rainfall of only 900 millimeters, with a minimum of 1 millimeter in August, while a station on the northern side of the central mountains has 6780 millimeters, the minimum of 214 millimeters (July) exceeding the maximum (February) at Asembagus.

Polar Temperature and Pressure Waves

Werner Schwerdtfeger. **Zur Theorie polarer Temperatur- und Luftdruckwellen.** Maps, diagrs. *Veröffentl. Geophys. Instituts der Univ. Leipzig*, Vol. 4, 1931, pp. 256–317.

The author endeavors to find an explanation for the periodicity of the polar temperature and pressure fluctuations made familiar to us through the daily synoptic weather charts of the northern hemisphere. This is arrived at by means of the concept of a sloughing off of cold masses of air from the persistent areas of cold air and high pressure in the polar regions and the movement of such detached masses towards the tropics, due to differences in temperature between polar air masses and the warmer air carried northward from the tropics and the middle latitudes through the general circulation of the atmosphere.

A discussion of pressure and wind relations in the lower layers of the atmosphere during the polar winter months and a description of the area of operations precede a theoretical consideration of the time required for bringing about conditions favorable for such a process. Defant has shown that at least 15 days are necessary for an interchange of air between the tropics and high latitudes and that in general from 20 to 30 days are required.

The author concludes from his studies, based perhaps too largely on consideration of conditions over the northern hemisphere during the winter of 1923–1924, that there is a 24-day polar wave from north to south and suggests a connection with one of the numerous periods of solar activity. The tendency to associate weather changes directly with variations in solar activity seems to be almost irresistible; a recent writer on weather and solar changes enumerates 13 periods varying in length from 3 days to 58 days and more than 60 periods varying in length between one year and 300 years.

A more thorough study of the excellent daily synoptic charts of the northern hemisphere available in recent years would seem to offer a more promising field for investigating problems of this nature.

OLIVER L. FASSIG

A NEW METEOROLOGICAL TEXTBOOK

DONALD S. PISTON. **Meteorology.** 187 pp.; maps, diagrs., ills., index. P. Blakiston's Son & Co., Philadelphia, 1931. $2.50. 9 x 6 inches.

During the past 20 years various meteorological readers and special books on meteorology have appeared, including two editions of Humphreys' thorough reference work, "The Physics of the Air"; but Milham's Meteorology (1912) has remained the general college text for elementary courses. For some time a modern American text of smaller size has been needed; now it has been furnished by Professor Piston, who has developed a course in meteorology as a branch of physics at the University of Maine. Professor Piston's book shows the preciseness to be expected of a physicist, but it has more the atmosphere of the laboratory than the freshness of the weather. Physical formulas are tossed into the text here and there without adequate introduction to the ordinary reader. Nevertheless, here is a well organized book that should be useful in all meteorology courses.

The subject is considered as a science, and quantitative values are derived and presented. In this first edition, the user will have to excuse a dozen or more typographical errors and other crudities, especially in some of the diagrams. The illustrations, however, are simple and generally carry their stories. Errors in meteorology are numerous but usually minor. It is stated that forests and water are poor absorbers of solar radiation, whereas aviators have long known that both appear darker than most other surfaces. Both by diagram and by text the author indicates, "It is not usual to have clouds or precipitation in the northern half of a cyclone!" The fact that Omaha is colder than Cheyenne in winter is ascribed to the greater radiation from Omaha through the dry air of spent föhns! Maps of storm tracks are inadequate. The sea-breeze diagram fails to show the higher pressure over the sea that drives the breeze landward.

But the balance swings to the favorable side when the easy, if not elegant style, the clear brief expositions, and apt comparisons are considered. The main features of modern advances in meteorology, including frontal phenomena in lows and the movement of air in, and dynamics of, cyclones and anticyclones, are presented in broad outline.

CHARLES F. BROOKS

INSECTS AND CLIMATE

B. P. UVAROV. **Insects and Climate.** Diagrs., bibliogr., indexes. *Trans. Entomological Society of London*, Vol. 79, 1931, pp. 1–247.

This monograph presents an excellent summary of knowledge in the field covered by its title. The works of about 800 authors, as appearing in the nearly 1200 publications cited, have been digested and arranged into an orderly compendium. Bibliography and indexes cover 61 pages and render the volume particularly useful.

The first section devotes 86 pages to the physical factors of insect life. Heat, humidity, light, pressure, electricity, and air movements are considered both separately and in combinations as they affect the life, reproduction, and activities of insects. The remaining 100 pages of text relate distribution, abundance, cycles, and various activities of insects to weather and climate in a most searching way. A comparatively short section on climate and weather in economic entomology includes observations relating to forecasting of insect activities and to the control of pests through the utilization of climatic factors. The geographer or climatolo-

gist will find much in it from a factual standpoint and may well profit from its methodology.

"It appears that temperature and humidity (or precipitation) are the two main factors limiting the distribution of insects. Indeed, the controlling value of other climatic factors is relatively small and very inconstant." Northward distribution in the northern hemisphere is often limited by the annual minimum temperature. The asparagus beetle for example, in North America, extends as far as the annual minimum isotherm of −23° C. Very few examples are known of insects being limited by excessive heat. However, the cabbage white butterfly reaches its southern limit of distribution in Palestine, where it reproduces only in winter, because summer month temperatures are sufficient to kill eggs and young larvae. Mean annual temperatures are more likely related to optimum conditions than to extreme limits of distribution. Various European vine moths flourish best under mean temperatures of from 8.5 to 16° C. and the tsetse fly at 26° C. The mean temperature of the summer months appears important in several cases. The northern limit of the migratory locust in Central Russia coincides with the summer isotherm of 13.6° C.

The climate of any locality, however, does not remain constant, and as a result the area of distribution of an insect may be extended one year and restricted the next. Extension of range may become permanent as the result of acclimatization. The cotton-boll weevil is a good example. It was thought that the beetle, coming from a southern climate, would soon be checked in its distribution by the temperature factor, but the insect proved to be capable of adjusting itself to new conditions, and its northward range has been gradually extended. Colonies of the potato beetle from the Chicago area were transferred to the desert climate of Arizona, and some of their progeny were brought back to Chicago. While the normal beetles in Chicago survived a winter to the extent of 79.46 per cent, in the case of beetles bred in Arizona for two generations only 7.5 per cent survived. Of the fourth Arizona generation only 2.25 per cent survived the Chicago winter, and of beetles bred in Arizona for eight generations none were able to hibernate in Chicago.

A sharp distinction exists between *climate* in the ordinary sense, the *ecoclimate*, within a habitat, such as forest, marsh, or on a sand dune, and, finally, *microclimate*, the conditions within the actual medium where the insect lives. The temperature of the side of a tree facing the sun may be 15–20° C. higher than that of the shady side. This is sufficient to account for a difference of 26–28 days in the period of emergence of the Oriental peach moth, *Cydia molesta*, from pupae on the north and south sides of trees. Standard weather data refer, as a rule, to an artificial microclimate within a kiosk and thus bear only a very distant and indirect relation to the ecoclimate or microclimate of the actual habitat of an insect. "The calculation of mean values from extremes only, the reduction of certain data to the sea level, and other methods, designed by meteorologists for the purpose of eliminating purely local and incidental variations in factors, tend to make the standard data of very little use to an ecologist." But the microclimate of the weather kiosk and that of an insect habitat are not unrelated phenomena, since they both depend upon the same meteorological events, and it should be possible to arrive empirically at formulae to express relationships between them.

Several interesting types of graphic expression are used in the paper. In addition to distributional maps the author relates such things as range and abundance to climatic factors in several *climatographs* (usually called *climographs*, "but it is scarcely worth while to sacrifice grammar in order to gain a syllable") wherein mean temperature and mean relative humidity are plotted on axes at right angles. A variation of the scheme, called *hythergraph*, utilizes temperature and precipitation. Their combined data are termed *thermohyets*, thus avoiding the cumbersome "temperature-precipitation conditions." Both climatographs and hythergraphs may utilize extreme rather than mean values. An interesting three-dimensional graph

shows the interrelation between annual mean temperature, total annual rainfall, and the severity of pest attack. A sharp note of warning is sounded against the employment of graphic, statistical, or mathematical methods in ecology that tend to give a "stamp of extreme exactitude and reliability to conclusions even if derived from faulty, though sufficiently numerous, data." Warnings are sounded repeatedly against easy and apparent generalization. One might readily gain the impression that the beet fly flourishes directly as the result of cool summers, but experimentation and study have demonstrated that in actuality it would thrive much better in hot summers were it not for the fact that its parasites are even more favored by heat. Predatory foes—birds, moles, etc.—may be affected by harsh winters to a greater extent than are the insects on which they feed, so that the latter flourish during the following seasons. The winters of 1916 and 1918 in Brazil were exceptionally severe. Cold and starvation killed so many insectivorous birds that the following summers were characterized by unusual numbers of insects. Epidemics of malaria in India follow heavy autumnal rains after severe droughts. Under such conditions grass flourishes, the numbers of cattle are greatly reduced, and an abundance of breeding places exist for mosquitoes. As there are fewer cattle to feed on, conditions are very favorable for the transmission of the malarial parasite from man to man.

No maps of world climates or insect regions on a world basis are attempted in the volume, nor do any generalizations or suggestions occur which would be particularly helpful for their construction. Throughout the work it is apparent that the concept of climate is that of the meteorologist rather than that of the regional climatologist.

RICHARD JOEL RUSSELL

THE PROBLEMS OF WATER WAVES

H. THORADE. **Probleme der Wasserwellen.** viii and 219 pp.; maps, diagrs., ills., bibliogr., indexes. (Probleme der Kosmischen Physik, Vols. 13 and 14.) Henri Grand, Hamburg, 1931. RM. 20. 9 x 6 inches.

Waves are phenomena of everyday occurrence both in the sea and in inland bodies of water. It is only within relatively recent times, however, that water waves have come within the scope of scientific investigation. This is a significant fact, attesting to the complexity of the subject. The observation and measurement of waves are attended with numerous difficulties. Obviously, too, waves on the scale found in nature do not lend themselves readily to experimental investigation. And on their theoretical side the problems require involved mathematical treatment. The theoretical investigator is therefore inclined to stress the mathematical formulation of the problems. As a result there is a wide gap between theory and observed fact.

Dr. Thorade in the volume under review aims at the bridging of this gap between theory and observation. After a short introductory chapter on the historical development of the subject, the author sketches briefly the basic hydrodynamic concepts underlying the mathematical study of waves. The subject proper is then developed under two heads, namely, surface waves and "Flutwellen." Unfortunately there is no exact English equivalent for the latter term; tide waves, which is one translation of the term, will not do; for, while tide waves are Flutwellen, other kinds of waves are likewise Flutwellen. The best translation of the term is perhaps "long waves."

Two chapters are devoted to surface waves, in which their form, movement, formation by winds, and propagation are discussed. Flutwellen are then considered in four chapters that deal respectively with the basic form of such waves, the changes brought about by bottom topography, the changes arising from the earth's rotation, and changes due to friction. The final chapter is devoted to special forms of long

waves, such as waves of translation, surf, and shallow-water waves. The treatment throughout is technical, and, although the author avoids full mathematical development of the various matters considered by referring to standard texts and memoirs, mathematical considerations are plentiful.

A valuable feature of the volume is the formulation of a number of problems, thirty-seven in fact, which follow the discussions of the different topics. By putting these matters into the precise form of problems the reader can more clearly visualize the actual state of knowledge regarding water waves, and the student can better grasp the problems that still await solution.

H. A. MARMER

REPORT ON THE STATUS OF OCEANOGRAPHICAL SCIENCE

Physics of the Earth—V, Oceanography. Prepared under the auspices of the Subsidiary Committee on Oceanography. v and 581 pp.; maps, diagrs., ills., index. *Bull. National Research Council No. 85*. National Research Council, Washington, 1932. $5.00. 10 x 7 inches.

"Oceanography" is the fifth volume of a series on the Physics of the Earth sponsored by the National Research Council with the intention of bringing together, in one series, reports on existing branches of geophysics. The stated purpose is "to give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status together with a forward-looking summary of its outstanding problems." Specialists in the several branches of oceanography set forth the present status of knowledge in their special fields in sixteen chapters.

Chapter 1, the introduction prepared by the chairman of the subcommittee on oceanography and editor of the publication, outlines the general domain of oceanography and gives a succinct résumé of the subjects treated. In Chapter 2 are given the general characteristics of each of the main ocean basins; the "deeps" and ocean ridges are described, and a general picture is outlined of the undersea topography of the world. Chapter 3 continues the narrative in relation to deep-sea deposits and stress is laid on the importance of stratification. The physical and chemical properties of sea water are treated in Chapters 4 and 5. In the former note in particular may be made of the sections on the effects of light, electric conductivity, and velocity of sound in sea water. The chemical properties of sea water are elaborated in Chapter 5 and being of such wide importance, especially with reference to life in the oceans and its economic bearings, are necessarily given large space in the book. "The sea is the greatest potential source of raw material known to man." Instruments and methods of securing samples of sea water are described, and the results of many sea-water analyses are given, including hydrogen ion concentration. Organic matter and the formation of oceanic salt deposits are discussed.

The general subject of the "movement of the sea" takes up the larger part of the book. Chapter 6 deals with "waves." The theory of wave motion of water is outlined, and wind waves in deep and in shallow water are discussed. In Chapter 7 is found a full discussion of the practical as well as theoretical questions of tidal phenomena, their causes, variations, harmonic analysis, tidal predictions, variations of sea level, and datum planes. Tidal currents are discussed, including types of these currents and their causes. Chapter 8 treats of the oceanic circulation from the standpoint of physical hydrodynamics and outlines the present-day methods of derivations of ocean currents from the three variables of gravity, pressure, and specific volume, together with a brief mention of the effect of secondary forces. Chapter 9 deals with the general circulation of ocean waters as a world phenomenon. Another factor affecting the movement of sea water in certain regions is clearly brought out in Chapter 10, which deals with the influence of the presence of ice in relation to its effects on temperature, salinity, and chemical conditions of the water bordering the

polar regions. A rapid advance in the knowledge is disclosed, and a generous list of references is given.

The descriptions of various typical instruments now being used in oceanographic work are given in Chapters 11 and 12. The short chapter following gives specifications for a deep sea-bottom sampler designed to bring up cores of several feet in length, giving better information of the stratification of bottom deposits than heretofore attainable. The last three chapters are concerned with the interrelations of oceanography, meteorology, biology, and geology in a way to make evident that all branches of geophysical science meet in and on the sea and that a full knowledge of any one branch requires some understanding of the others. †R. L. FARIS

SOCIAL PROBLEMS OF THE RURAL COMMUNITY

DWIGHT SANDERSON. **The Rural Community: The Natural History of a Sociological Group.** ix and 723 pp.; maps, diagr., ills., bibliogr., indexes. Ginn and Co., Boston, New York, 1932. $4.40. 8½ x 6 inches.

This interesting survey makes a feature of lengthy extracts from previous writers on the various questions raised but, nevertheless, achieves a notable expression of its author's personality and point of view, minimizing controversy and avoiding efforts to force the multifariousness of the facts concerned into the framework of a theory. The author has read widely, and one of the only omissions of any consequence is that of the reports of the Commission de l'Habitat Rural of the International Geographical Congress, some of which no doubt appeared too late to be used, though the author rightly emphasizes the valuable thought of its president, Professor Demangeon, expressed in his articles in the *Annales de Géographie.*

Sanderson sees the spread of agriculture over many lands as a number of efforts by various peoples with a considerable common background meeting and more or less solving partially analogous problems by devices which are similar in some cases because of common inheritance but often because of similarities of circumstance. The author's ultimate aim is to study the modern problems of the group of separate farms around a more or less developed community center in the United States; and to this ensemble the name "rural community" is given in the stricter sense, but the name is also used in the wider sense to cover agricultural groups of all times and places. He is anxious to get freedom from the old error that saw stages of social development as facts of almost universal validity, as well as from the theory that oversimplifies the matter by interpreting everything as resulting from a diffusion of a certain culture from one center.

Perhaps there is not quite adequate appreciation of the evidence from prehistoric studies concerning the agricultural groups which, from the third millennium before the Christian era onwards, have lived in particular localities on the European loess, and of the indications of former agglomerated village groups in areas of the west of Europe that were quoted, by Meitzen for example, as typical instances of the dispersed habitat (Einzelhof). But the result of taking such matters into further consideration would not sensibly modify the author's general views.

He thinks that one may argue back to the clan village, the colonized village, the village due to "precipitation" of nomads, the village or hamlet arising as a group of cabins of *Lidi, coloni* or slaves, such as one finds in France as a result of Roman occupation, the community of political origin connected with the appropriation of a share of the land by conquerors, and the village that has its scheme controlled by the growth of the manorial system in Europe. An interesting section on the joint family gives the author opportunity to emphasize his point of view that this is one of a number of forms, not one of a necessary succession of stages; but the reader would like to get further discussion of its widespread distribution, especially among

peoples affected by the steppe borders of the Old World. Students of geography of almost every region or period, from antiquity in the East to modern times in China, Egypt, Europe, or America, will find in this work a source of thought and a guide to bibliography for which the author deserves warm thanks.

H. J. FLEURE

RURAL SETTLEMENT IN LITHUANIA

WERNER ESSEN. **Die ländlichen Siedlungen in Litauen mit besonderer Berücksichtigung ihrer Bevölkerungsverhältnisse.** Vol. 1, 135 pp.; Vol. 2, maps, diagrs., ills. *Veröffentl. Staatlich-sächsischen Forschungsinst. für Völkerkunde in Leipzig*, Ser. 2, Vol. 1. R. Voigtländer, Leipzig, 1931. RM. 20. 11¼ x 8 inches.

Selecting Lithuania as his experimental ground the author seeks to establish a working principle for analyzing the geography of settlement in any region for which statistical censuses are available. By settlement is meant every abode, whether it be a single structure or a group of related structures such as a farmstead or other structures used for miscellaneous economic activities. The term is quite comprehensive. In association with rural settlements the cultivated lands with their characteristics, belonging to the community, are considered inherent parts of it. Important as the settlement itself is, it is not the primary consideration in the problem, but rather the occupants. Consequently, in the attempt to arrive at a genetic explanation of settlements one must fall back on a consideration of the cultural level of the inhabitants, their occupations, and their nationality.

To interpret the distribution of settlements, particularly of rural settlements, a statistical schematic method is proposed and applied. In so far as it is based on the mathematical theory of probability and involves a method already applied to the field of geography by Bruno Dietrich (Die Methode der natürlichen Gruppenbildung in volkspolitischen, geographischen, und statistischen Untersuchungen, *Volk unter Völkern, Bücher des Deutschtums*, Vol. 1, Breslau, 1925, pp. 410–414) it is not new. However, the idea has been carried much farther here than by Dietrich and others to include new applications and to present a somewhat different logic.

No attempt will be made here to discuss the mathematics: we merely note that they involve a quantitative method of plotting numerous distributional elements associated with the characteristics of settlements, which seems to provide a higher degree of accuracy than other methods more widely employed. Such items as percentages of land cultivated for particular crops, the distribution of different kinds of villages and density of population calculated with respect to such different aspects as religion, nationality, proprietorship of land, and a variety of vital statistics are worked out in accordance with the formulae devised by the author. The philosophy aims to make possible a more balanced point of view than has been secured through simplified arithmetical methods. Greater flexibility in handling data and in plotting them is derived through the application of the mathematical theory.

EUGENE VAN CLEEF

A FRENCH COUNTRYSIDE

PIERRE DEFFONTAINES. **Les hommes et leurs travaux dans les pays de la Moyenne Garonne (Agenais, Bas-Quercy).** xxxiii and 462 pp.; diagrs., ills., bibliogr. (Mémoires et Travaux des Facultés Catholiques de Lille, No. 39.) Lille, 1932. 10 x 6½ inches.

M. Deffontaines dedicates his book to St. Francis of Assisi—"voir pour comprendre, mais aussi voir pour chanter," a happy thought, for this is a work that "sings." The organization is as admirable as it is unusual. A map of "les pays et les paysages" forms the frontispiece; then comes an "album" of 63 photographs

fully described; then a glossary of local terms. The introduction inquires into the identity of the region, difficult to define in a transition country, lacking individuality. The text is in two parts, "l'effectif humain" and "les horizons de travail." A bibliography concludes the volume—there is no index, alas—and here tribute is paid to Jean Brunhes whose genial influence indeed lives in these pages. For special mention we select the graphs illustrating the depopulation of the country in the nineteenth century, for the middle Garonne is one of the "black spots" in the depopulation map of France (see for instance Louis Bouis: Le mouvement de dépopulation en France, *Journ. Soc. de Statistique de Paris*, Vol. 73, 1932, pp. 275–297). The tide, however, has turned with the recent immigration into the country, repeating history, for this is "un pays sans cesse repeuplé." And justly so, M. Deffontaines would have us believe. We repeat his quotation from Taine: "Ni collines, ni rien, pas même une grande plaine; tout est petit ou ordinaire. On dit seulement: C'est un bon pays."

A Festschrift from Grenoble

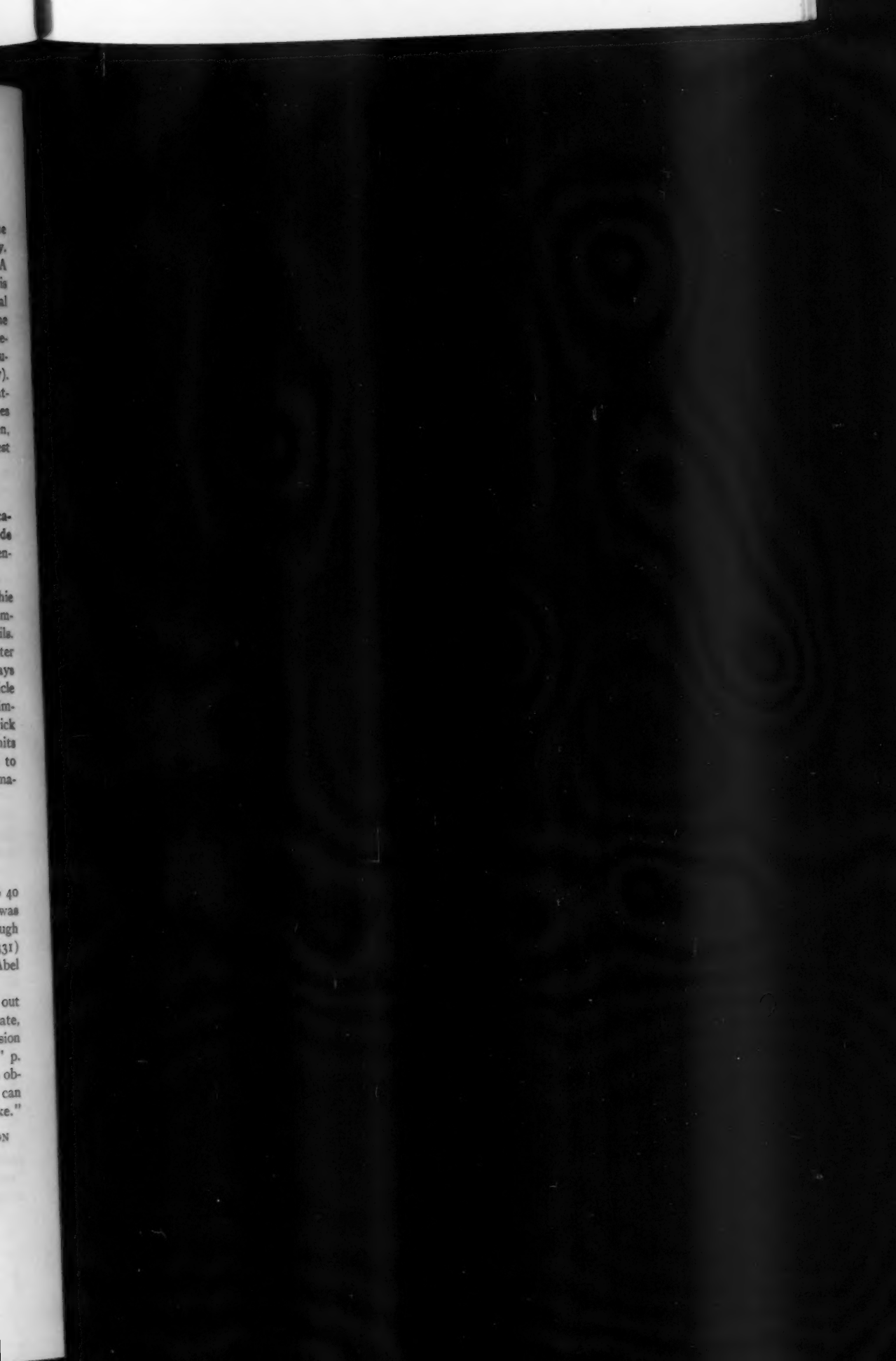
Mélanges géographiques offerts par ses élèves à Raoul Blanchard . . . à l'occasion du vingt-cinquième anniversaire de l'Institut de Géographie Alpine de Grenoble. 670 pp.; maps, diagrs., ills. Institut de Géographie Alpine, Grenoble, 1932. 10 x 6¾ inches.

This volume, celebrating a quarter-century's work of the Institut de Géographie Alpine at Grenoble and dedicated to its founder Professor Raoul Blanchard, comprises a list of his writings (nearly 200 items) and twenty-nine essays by pupils. Many of the essays are reprinted from the *Revue de Géographie Alpine*. The greater number naturally deal with the French Alps and adjacent regions. Two essays come from America—Millicent Todd Bingham contributes a well illustrated article on "La Floride du Sud-Est et la ville de Miami," from which we may note the importance attached to Miami as an aviation center as well as a winter resort. Roderick Peattie, following earlier work on mountain geography in Europe (see Height Limits of Mountain Economies, *Geogr. Rev.*, Vol. 21, 1931, pp. 415–428) calls attention to the desirability of such studies in America ("Les apports de l'Amérique à la climatologie de montagne").

CORRESPONDENCE

Illiteracy in Finland

Globen for March (p. 31), 1932, finds fault with me for saying that from 30 to 40 per cent of the Finns are illiterate. As a matter of fact I did not say so. I was wrongly credited with the statement in the January number of *Globen* (p. 9) through the misreading of a notice in the *Geographical Review* for April, 1931 (pp. 330–331) of the bulletin "Illiteracy in the Several Countries of the World" by James F. Abel and Norman J. Bond (*Bur. of Education Bull.*, 1929, No. 4).

The writer in the March number of *Globen* is, of course, correct in pointing out the low degree of illiteracy in Finland—17 per cent of the total population illiterate, or 1 per cent of the population aged 15 or above. I gave this high literacy expression in the culture map in my "Exercises in Human Geography," 1931 ("Schools," p. 106). I quote from page 108: "Illiteracy figures might be of interest if they were obtainable for all countries on a common basis, but to ascertain how many people can effectively read and write is probably too difficult a task for any census to undertake."

Mark Jefferson